Devoted to
TEXTILE
CHEMISTRY
BLEACHING
DYEING
PRINTING
FINISHING

AMERICAN DYESTUFF REPORTER

MARCH 8, 1948
VOLUME 37, No. 5

MAR 12

What's in a name...

is an old question for which experience has taught each of us the only answer.

A name like *Solophenyl* carries the assurance that there are no faster-to-light Direct colors for Cotton, Rayon and mixed fabrics.

You are buying the "tops" in Direct colors when you buy Geigy *Solophenyl** colors.

* *Registered U. S. Patent Office*

GEIGY COMPANY, INC.

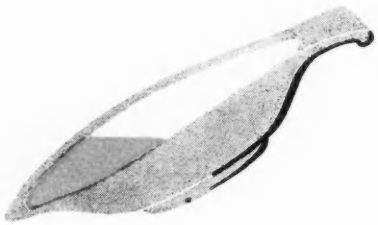
89-91 BARCLAY STREET
Boston · Philadelphia
Charlotte · Portland, Ore.
Chicago · Providence
Toronto

Geigy

NEW YORK—NEW YORK
In Great Britain
The Geigy Co., Ltd.
National Buildings
Parsonage, Manchester

OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS

REPELS WATER.....



RESISTS STAINS.....

IN A

WIDE

VARIETY

OF TEXTILES...

PARAMUL 115

WATER REPELLENT

PARAMUL°° 115 Water Repellent, – another important development of Cyanamid Research for the textile industry – has a double purpose in life: to provide a better water repellency and a superior resistance to stains. And how *well* it does *both* is proved many times a day in a wide variety of fabrics – cottons, rayons, linens and woolens – for outerwear and equipment purposes.

An aqueous solution of wax and aluminum salts, PARAMUL 115 Water Repellent saves time and money in application, is easy to use, odorless and harmless to skin and fabric. It provides complete stability over a wide range of temperatures and can be safely stored for a long time.

Profit by Cyanamid's extensive research facilities by specifying PARAMUL 115 Water Repellent for your fabrics. Take advantage of Cyanamid's expert technical staff to achieve the most superior results *possible* in water repellency and stain resistance.

AMONG CYANAMID PRODUCTS FOR THE TEXTILE INDUSTRY ARE:

AQUASOL° Sulfonated Castor Oils; NO-ODOROL° Finishing Oils; DECERESOL° Wetting Agents; PARAMUL°° 115 Water Repellent; Penetrants, Softeners, Finishes, Sizing Compounds, and other specialties and Heavy Chemicals. For low-cost chemical equivalent of distilled H_2O... FILT-R-STIL° Demineralizing Units.

°Reg. U. S. Pat. Off. °°Trade-mark

★ ★ ★

SALES OFFICES: Boston, Mass.; Philadelphia, Pa.; Pittsburgh, Pa.; Baltimore, Md.; Charlotte, N. C.; Cleveland, Ohio; Cincinnati, Ohio; Chicago, Ill.; Detroit, Mich.; Kalamazoo, Mich.; St. Louis, Mo.; Los Angeles, Calif.; San Francisco, Calif.; Seattle, Wash. In Canada: Dillons Chemical Company, Ltd., Montreal and Toronto.

American
Cyanamid Company

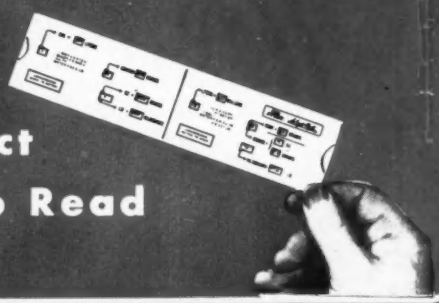
Industrial Chemicals Division

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

American Dyestuff Reporter, Vol. 37, No. 5, March 8, 1948. Published every other Monday. Copyright, 1948, by Howes Publishing Co., Inc., One Madison Ave., New York 10, N. Y. Domestic subscription, $5.00; Canadian, $6.00; Foreign, $10.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

Designed Especially For You-

Handy
Compact
Easy to Read



Ciba's NEW DYERS' Slyd-Rul

(Made of plastic)

DYESTUFFS • CHEMICALS • INTERMEDIATES

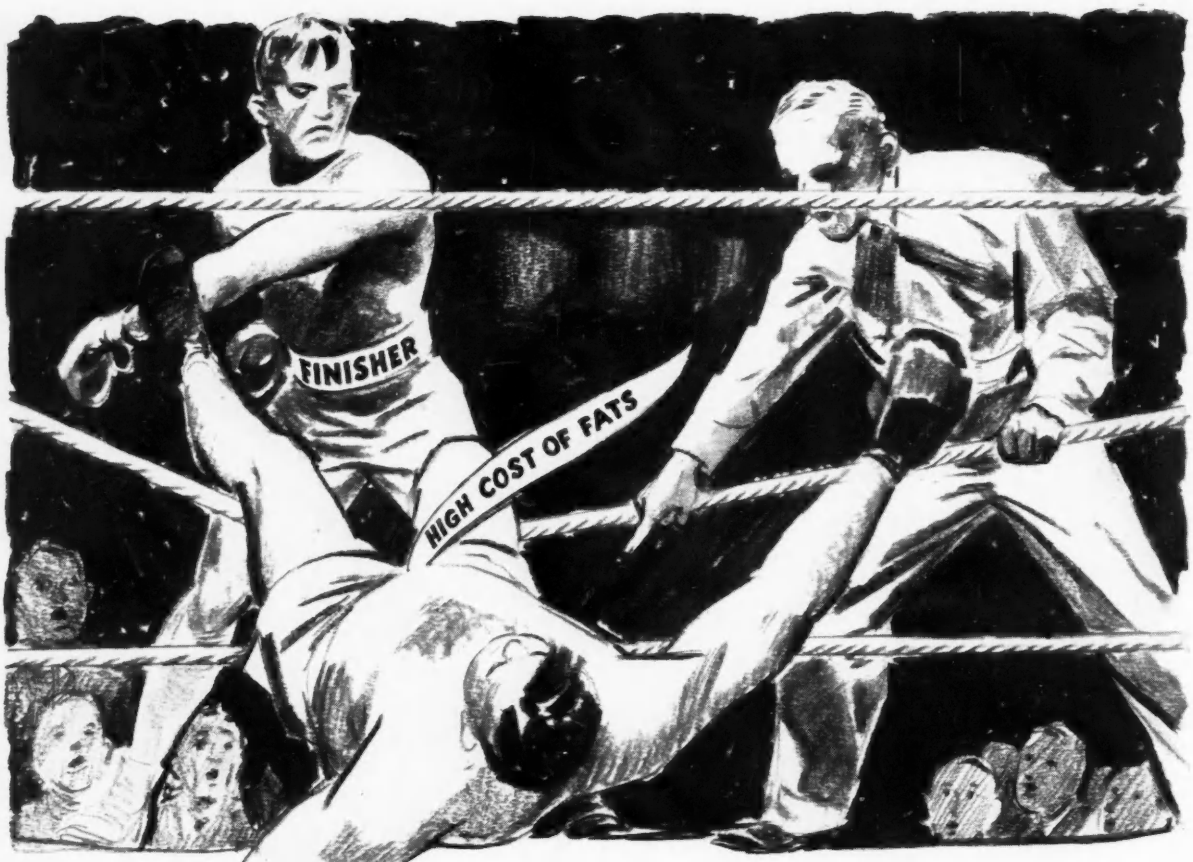
CIBA COMPANY INC.

Greenwich & Morton Sts.
NEW YORK

BOSTON · CHICAGO · MONTREAL · CHARLOTTE
PROVIDENCE · SAN FRANCISCO · PHILADELPHIA

VAT DYES OF THE DOW CHEMICAL COMPANY

Another example of Ciba's technical service to make your job easier.



How to lick the high cost of fats

You hardly need to be reminded that the cost of most fats for finishing is rapidly becoming prohibitive. You may or may not realize however that there are products which can be used for these purposes which give better results at comparable cost or equal results at lower cost.

Among such products in the AHCO line are the following:—

AHCOVELS*

If your problem is primarily one of softening, one of our AHCOVELS will solve it. Although constantly improved, these synthetic substantive softeners have not changed in price for seven years. They give an unsurpassed hand, softness and drape to cotton, rayon, nylon, acetate or wool fabrics. Almost pure white in color, they are highly resistant to yellowing, very stable when subjected to heat and the E, F and R types do NOT affect the light fastness of colors. Small quantities, compared with sulphonated tallows, are required for a given result.

SOFTENER CDEP

If you need extra body with softness, SOFTENER CDEP is the solution to your cost and quality problems. It gives the same effect as sulphonated tallows but is considerably cheaper on a yard for yard basis.

When we suggest that you try these products, we are not asking you to experiment. Ahcovels are the most popular substantive softeners on the market and SOFTENER CDEP has also proved its value in volume production.

Let us recommend a formula for your softening or weighting problems.

*Trademark Reg.

ARNOLD, HOFFMAN & CO. INCORPORATED

MANUFACTURING CHEMISTS

ESTABLISHED 1815 • PLANTS AT DIGHTON, MASS. AND CHARLOTTE, N. C.

PROVIDENCE, RHODE ISLAND

NEW YORK • BOSTON • PHILADELPHIA • CHARLOTTE

A NEW MULTI-PURPOSE
SYNTHETIC AUXILIARY
REPCOLENE
REPCOLENE is a clear, free flowing, non-jelling liquid.
REPCOLENE is an effective wetting, dispersing and levelling agent.
REPCOLENE is extremely stable and its activity is not affected by acids, alkalies, lime or the salts usually found in hard water.
REPCOLENE when dried into the fabric makes them highly absorbent.

REFINED PRODUCTS CORPORATION

Lyndhurst • New Jersey

• Manufacturers of PERMA-CIDE, the approved, outstanding, mildew-proofing agent

Southern Representative: DYER S. MOSS, 1301 Liberty Life Bldg., Charlotte, North Carolina

New England Representatives: E. L. LEGG, P. O. Box 597, Providence, R. I.
CLARENCE E. MOSS, 19 Wilson Ave., Rumford (16) R. I.

Canadian Selling Agents: Carbic Color and Chemical Co., Inc., 56 McNab Street South, Hamilton, Ontario

Exporting Agent: Chem-Col Company, 82 Wall St., New York City.

NOW 4 TEXTILE OILS TO CHOOSE FROM

✓ solube 463

Self-emulsifiable easily-scoured oil. A very stable wool and worsted lubricant designed specifically to reduce the amounts of soap needed in scouring (and fulling), some fabrics require none. Solube 463 most readily scourable of any oil available.

✓ lard oil

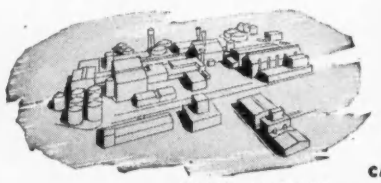
Lard Oil (winter strained). Emersol Lard Oils are characterized by a uniformity uncommon among lard oils. They conform to standard "Industry" specifications and can be furnished with pour points lower than standard specifications.

✓ oleic acid (red oil)

Highest stability red oils. All grades of Emery's Oleic acids exhibit unique stability as demonstrated by their resistance to OXIDATION and RANCIDITY; better performance in Mackay Test.

✓ wool and worsted oils

Self-emulsifiable mineral-type oils. Twitchell Worsted Oil MC and Wool Oil 308, sulfonated mineral type oils, have long been accepted for wool and worsted stock lubrication. These extremely stable oils are recommended for normal uses not requiring the unusual scourability of Twitchell Oil 463.



EMERY INDUSTRIES, INC.

TWITCHELL TEXTILE OILS

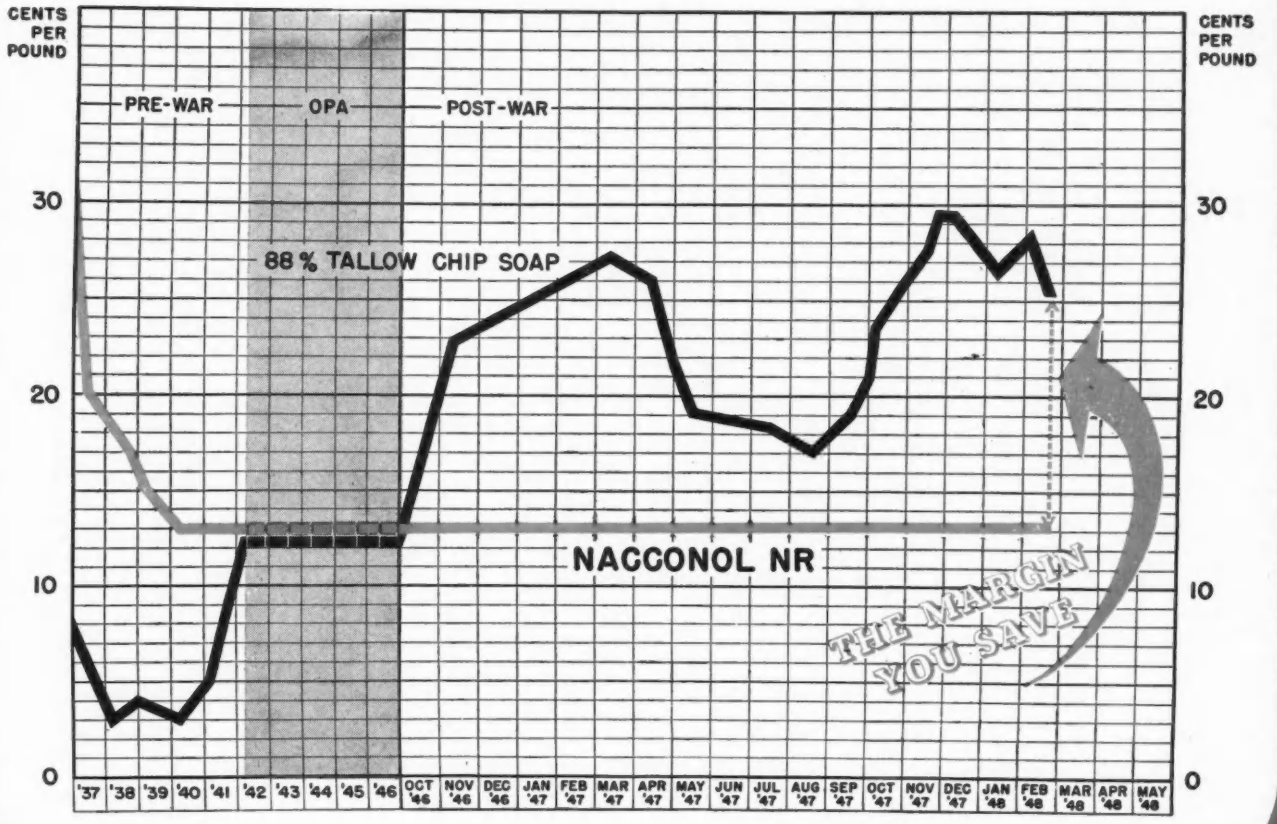
CAREW TOWER • CINCINNATI 2, OHIO

3002 Woolworth Building, NEW YORK 7, N. Y. | 187 Perry Street, LOWELL, MASSACHUSETTS | 401 N. Broad Street, PHILADELPHIA 8, PA.

STEARIC ACID • OLEIC ACID • ANIMAL AND VEGETABLE FATTY ACIDS • TWITCHELL PRODUCTS • PLASTICIZERS

Pictures Speak Louder Than Words

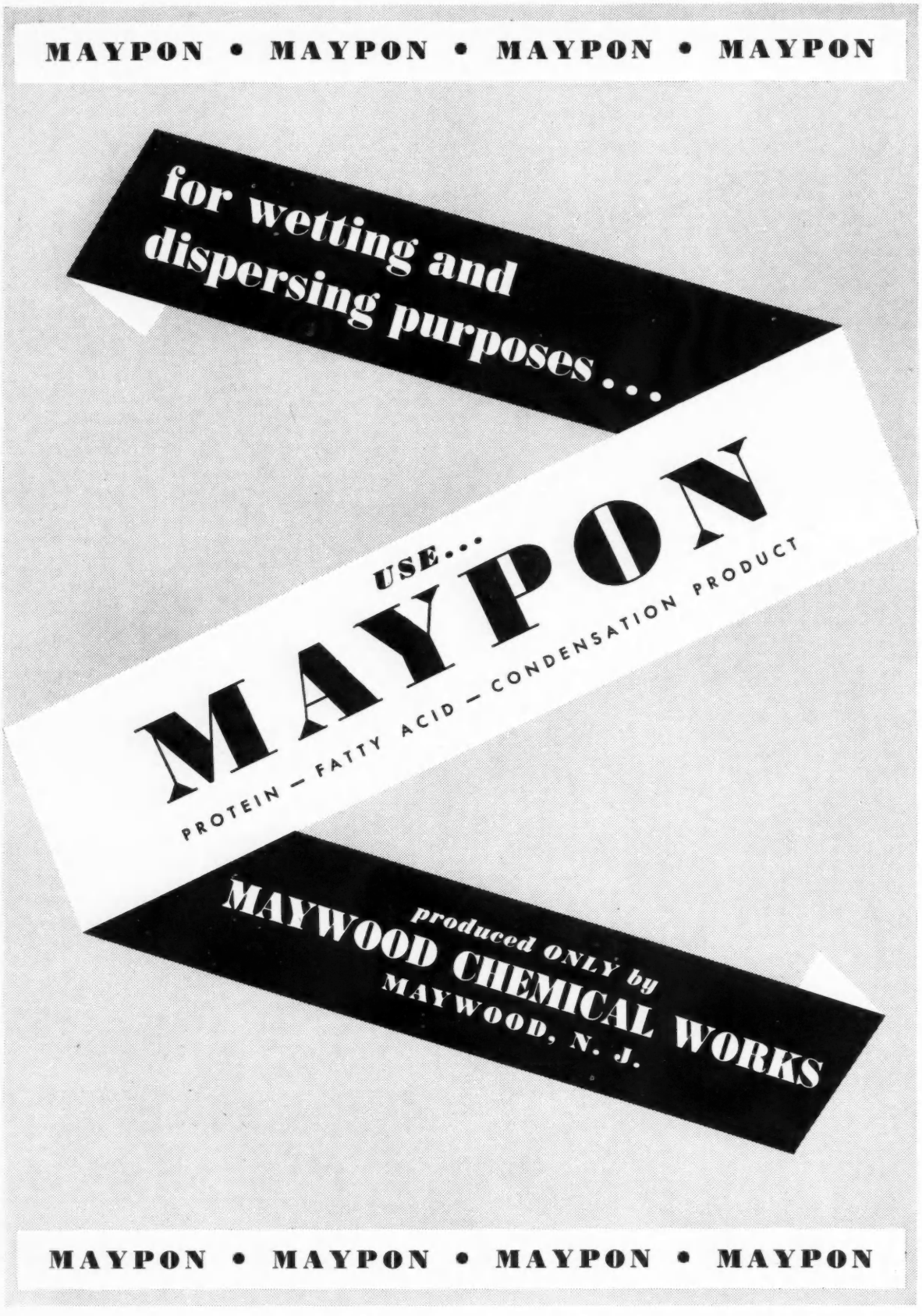
COST COMPARISON - NACCONOL NR vs SOAP


CENTS PER POUND
PRE-WAR
OPA
POST-WAR
30
20
10
0
88% TALLOW CHIP SOAP
NACCONOL NR
THE MARGIN YOU SAVE
'37 '38 '39 '40 '41 '42 '43 '44 '45 '46 OCT '46 NOV '46 DEC '46 JAN '47 FEB '47 MAR '47 APR '47 MAY '47 JUN '47 JUL '47 AUG '47 SEP '47 OCT '47 NOV '47 DEC '47 JAN '48 FEB '48 MAR '48 APR '48 MAY '48

Adopt **NACCONOL NR**
and cut your soap costs

National Aniline DIVISION • ALLIED CHEMICAL & DYE CORPORATION

40 RECTOR ST., NEW YORK 6, N.Y. • BOSTON • PROVIDENCE • PHILADELPHIA • CHICAGO • SAN FRANCISCO • PORTLAND, ORE. GREENSBORO • CHARLOTTE • ATLANTA • NEW ORLEANS • CHATTANOOGA • TORONTO


MAYPON • MAYPON • MAYPON • MAYPON
for wetting and dispersing purposes . . .
USE . . .
MAYPON
PROTEIN — FATTY ACID — CONDENSATION PRODUCT
produced ONLY by
MAYWOOD CHEMICAL WORKS
MAYWOOD, N. J.
MAYPON • MAYPON • MAYPON • MAYPON

AMANTHRENE* VAT COLORS
provide the answer to the demand for
better color fastness in textiles.

Amanthrene

OLIVE GREEN B

in paste or
double powder form

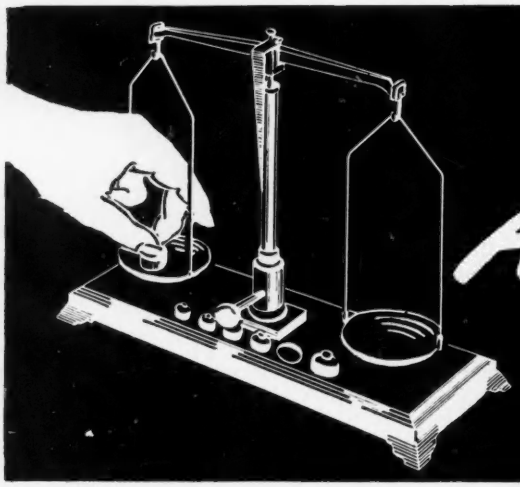
Classified 1-A all through the war, this veteran vat color, now released for civilian use, offers a high degree of fastness to light, washing, chlorine and perspiration.

A pleasing self shade — a base color for Forest and Bottle Greens and a contributing item for Olive Drab. Printability excellent — well suited for use on cotton and rayon by every manner of vat application.

Another of the Amanthrene range of superior vat colors. For detailed information on the whole range available, as well as data regarding your own particular requirements, consult our nearest branch. A.A.P. technicians are always happy to be of service.

AMERICAN ANILINE PRODUCTS, INC., 50 Union Square, New York, N. Y. • ***Plant:*** Lock Haven, Pa.
Branches: Boston, Mass. • Providence, R. I. • Philadelphia, Pa. • Charlotte, N. C. • Chicago, Ill. • Los Angeles, Cal.
Chattanooga, Tenn. • **Dominion Anilines & Chemicals Ltd.** • Toronto, Canada • Montreal, Canada

*Reg. U. S. Pat. Off.



You've Got to Measure

ACCURATELY

to Get the Best Results!

For Accurate Salt Measurement

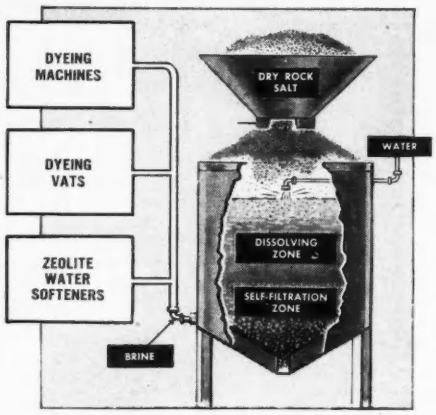
"PASS the SALT" BY LIXATOR

EVERY DYER knows that salt is a top-flight exhausting agent ... that it must be accurately measured to insure complete exhausting without waste... and further that it must also be uniformly distributed in the dye bath to prevent spotting, streaking and white edges. The question is *how*.

With Lixate brine accurate salt measurement and uniform distribution are assured. For the Lixator automatically and continuously makes 100% saturated, crystal clear brine. Since each gallon of Lixate brine *always* contains 2.65 lbs. of salt—a definite volume of Lixate brine supplies a definite quantity of salt. The trouble and waste of measuring salt by hand or by mechanical devices, or of measuring by weight without regard to water absorption during storage, are things of the past. And added to the dye bath, salt, as brine, is immediately diluted and dispersed throughout.

Leading companies in your industry and many others are availing themselves of the Lixator's ability to measure salt accurately ... to reduce labor and handling costs and to improve the quality of their products. It will pay you to investigate the Lixate Process for making brine for your plant.

HOW THE LIXATOR WORKS



In the upper zone—Flowing through a bed of rock salt which is continuously replenished by gravity feed, water dissolves salt to form 100% saturated brine. **In the lower zone**—Through use of the self-filtration principle *originated by International*, the saturated brine is thoroughly filtered through a bed of undissolved rock salt. The rock salt itself filters the brine. Nothing else is needed.

WHAT THE LIXATOR PROVIDES

- ✓ Chemical and bacterial purity to meet the most exacting standards for brine
- ✓ Unvarying salt content of 2.65 pounds per gallon of brine
- ✓ Crystal-clear brine
- ✓ Continuous supply of brine
- ✓ Automatic salt and water feed to Lixator
- ✓ Inexpensive, rapid distribution of brine to points of use by pump and piping

Get the full story on why accurate salt measurement is *always* possible with Lixate brine. Send for your copy of our *free* pamphlet *today!*

INTERNATIONAL SALT CO., INC., Dept. ADR3, Scranton, Pa.
Gentlemen.
Please mail absolutely free your pamphlet, "How Lixate Brine Solves the Problem of Accurate Salt Measurement."

Name _____

Firm _____

Street _____

City _____ *State* _____

The LIXATE Process
Reg. U. S. Pat. Off.
for making brine
INTERNATIONAL SALT COMPANY, INC.
Scranton, Pa.

IGEPALS

outstanding non-ionic surface active agents for wool, cotton and synthetic fibers.

- Excellent wetting, emulsifying and scouring properties
- Quick rinsing
- Readily soluble at all temperatures
- Equally effective in hard or soft water
- Neutral reaction
- Resistant to acids and alkalis
- Non-electrolyte—non-reactive
- Compatible with anionic and cationic compounds

Our skilled technicians are available for plant demonstrations.

GENERAL DYESTUFF CORPORATION

435 HUDSON STREET, NEW YORK 14, NEW YORK

BOSTON · CHARLOTTE · CHICAGO · PHILADELPHIA · PROVIDENCE · SAN FRANCISCO

NYANZA

ANILINE & ALIZARINE COLORS

•

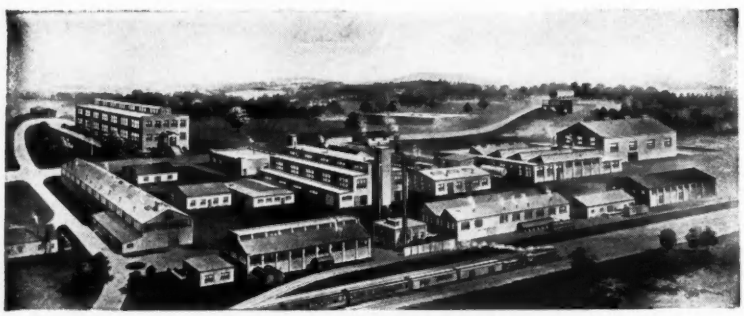
TEXTILE CHEMICALS

•

FINISHING MATERIALS

FOR

WOOL—COTTON—RAYON—ACETATE
AND MIXED FIBERS



FACTORY AT ASHLAND, MASSACHUSETTS

NYANZA COLOR & CHEMICAL COMPANY, Inc.

109 WORTH STREET NEW YORK 13, N. Y.

FACTORIES:

CHEMICAL MANUFACTURING CO., ASHLAND, MASS. • NEW BRUNSWICK CHEMICAL CO., NEWARK, N J.

BRANCHES:

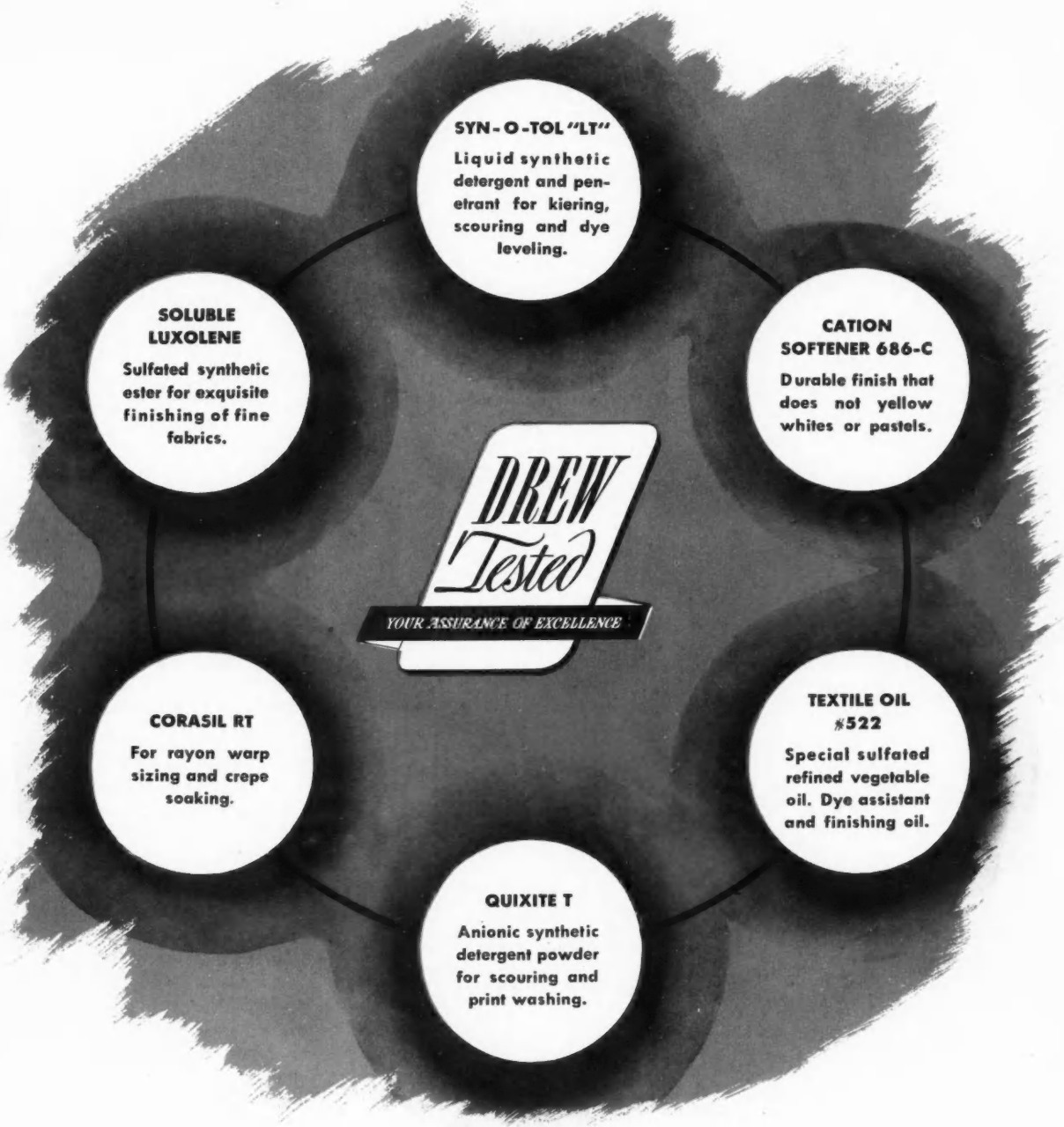
ASHLAND, MASSACHUSETTS

549 West Randolph St., Chicago, Ill. • 635 Drexel Bldg., Philadelphia, Pa. • 115 S.W. Fourth Ave., Portland, Ore.

304 E. Moorehead St., Charlotte, N. C.

CANADIAN AGENTS:

Charles Albert Smith Limited, 123 Liberty St., Toronto, Canada


SYN-O-TOL "LT"
Liquid synthetic detergent and penetrant for kiering, scouring and dye leveling.
CATION SOFTENER 686-C
Durable finish that does not yellow whites or pastels.
SOLUBLE LUXOLENE
Sulfated synthetic ester for exquisite finishing of fine fabrics.
DREW Tested
YOUR ASSURANCE OF EXCELLENCE
TEXTILE OIL #522
Special sulfated refined vegetable oil. Dye assistant and finishing oil.
CORASIL RT
For rayon warp sizing and crepe soaking.
QUIXITE T
Anionic synthetic detergent powder for scouring and print washing.

OUTSTANDING PRODUCTS FOR COTTON AND RAYON PROCESSING

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.
FACTORY & LABORATORIES: BOONTON, N. J.
BRANCH OFFICES
Chicago • Boston • Greenville, S. C. • Montreal, Canada
Rio de Janeiro, Brazil • Buenos Aires, Argentina

The Cadillac-look in Stockings

Stockings finished with Filaseal Resin Finishes return to their original shape even after creasing or handling . . . never look counter-tossed. Filaseal imparts to stockings the added body and snag resistance necessary for high speed boarding, pairing, folding and packaging. For increased production of firsts, for stocking fabrics that sell faster, find out about this remarkable Amalgamated finish today.

AMALGAMATED CHEMICAL CORP.
Phila. 34, Pa. : : Southern Representative
R. A. Bruce, P.O. Box 35, Greensboro, N.C.

Filaseal

— to cut down snags and pulls

Stockings that look "handled" stay on the hosiery counter until all the "fresh" stockings are sold.

Stockings finished with Filaseal sell faster because they look better . . . stay smooth and fresh.

The products of Amalgamated Chemical Corporation include Hosiery Finishes, Wetting Agents, Penetrants, Softeners, Detergents, Soaps, Water Repellent Finishes.

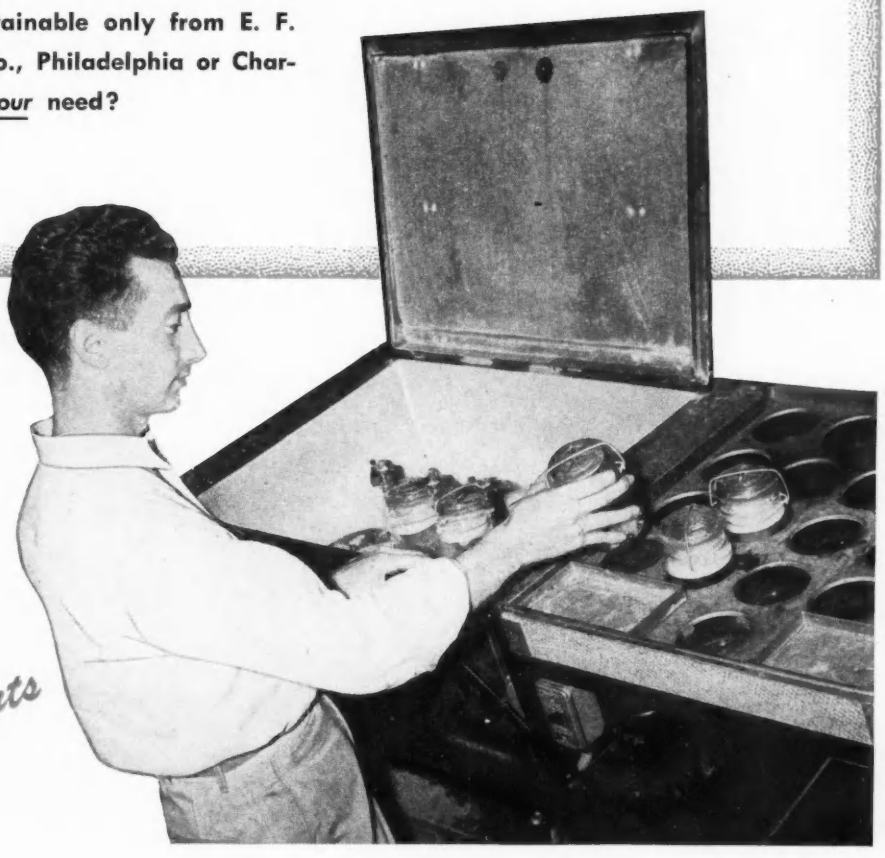
How do we know how thoroughly CERFAK cleans?

Nothing's left to guesswork in evaluating Houghton's CERFAK. This series of synthetic detergents, born some ten years ago in our laboratories, has been rigidly tested there and in the field, to determine definitely how efficient each type is, and for what jobs it should be used.

The Launderometer, shown below, washes a number of artificially soiled fabric samples simultaneously. Each jar contains a different detergent solution, and each washed sample is checked by Reflectometer for comparative cleanliness.

But that's only the beginning. The real test is in the mill. No type of CERFAK is recommended for a particular wet processing job until it has undergone actual production test and has been found O. K. for the application. Trained textile technicians conduct these trial runs under actual plant conditions.

Results prove that there is a type of CERFAK best suited to every cleaning need, offering an excellent money value, and obtainable only from E. F. Houghton & Co., Philadelphia or Charlotte. What's *your* need?



Houghton's Cerfak Detergents

Savings UP with NOPCO* FUA

The self-fulling, self-scouring wool oil whose remarkable versatility is proven daily in countless woolen mills, on all woolen processes.

IN THE CARDING PROCESS

. . . NOPCO FUA cuts down fly . . . won't gum or load the cards. It makes possible longer runs before stripping. It helps preserve natural life and cushion of the leather rub roll aprons, giving you a loftier, rounder roving. NOPCO FUA is non-corrosive. In short —NOPCO FUA makes possible extensive savings in time and equipment.

IN THE SPINNING PROCESS

. . . Here again, NOPCO FUA reduces ultimate costs. It is non-oxidizable. It does not become set in the yarn during steaming nor in the grey goods after steaming and crabbing, to cause cloudy, shady piece dyeings. NOPCO FUA performs equally well on mules or frames.

IN THE DYEING PROCESS

. . . On piece dyes, the minute residuum of NOPCO FUA (0.2% or less) is an actual aid to level dyeing. NOPCO FUA is a leveling agent in its own right.

IN THE FULLING AND SCOURING PROCESSES

. . . NOPCO FUA achieves remarkable results when used alone. No soaps or detergents are required. (Small amounts of a polyphosphate solution added to the soda ash solution enhance sudsing.) Goods slide better in the fulling mill . . . tangles or knock-offs are prevented. Further, NOPCO FUA produces quick, uniform shrinkage and reduced rinsing time.

NOTE THESE FURTHER ADVANTAGES OF NOPCO FUA

NOPCO FUA performs like an oil on the fibers during carding and spinning and like a soap in wet finishing. It is all fatty . . . contains no mineral oil or hydrocarbons. It is salt and ash free. NOPCO FUA needs no added equipment or change in procedure.

All in all, no other wool oil can lay claim to so many exclusive advantages as NOPCO FUA. No other can duplicate its versatile performance.

Send for Technical Bulletin T-23. It describes NOPCO FUA's aid to better, faster, more economical woolen processing.

NOPCO CHEMICAL COMPANY, Harrison, N. J.

Formerly National Oil Products Company

BRANCHES: BOSTON • CHICAGO • CEDARTOWN, GA. • RICHMOND, CALIF.

NOPCO TRADEMARK EVOLVED THRU RESEARCH

*Reg. U. S. Pat. Off.

NOPCO FUA

Self-Fulling Self-Scouring Wool Oil

Eastman Acetate Dyestuffs

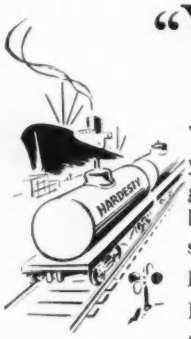
Produced for synthetic fabrics, Eastman Acetate Dyestuffs are available in a variety of colors for practically every method of dyeing and printing. There are dyes well adapted to discharge or application printing. Other Eastman Acetate Dyestuffs can be used on both jig and box, at either high or low temperatures, with excellent build-up and leveling properties. Fabric dyers may take advantage of the special fastness properties of Eastman dyes developed to withstand fading under various conditions. The full benefit of Eastman research on dyeing problems is extended without obligation to users of these dyestuffs.

Eastman Acetate Dyestuffs are sold in the United States through Tennessee Eastman Corporation in Kingsport, Tennessee, and Lodi, N. J.; in Canada, through Clough Dyestuff Company, Ltd., 33 St. Mathieu Street, St. Laurent, Quebec.

Tennessee Eastman Corporation

—A SUBSIDIARY OF EASTMAN KODAK COMPANY

"You Can't Miss With Hardesty"



". . . because Hardesty *won't* miss with you. Dependable—that's a word that gets kicked around a lot these days—but it really fits Hardesty. When they say they'll have a shipment in your plant on a certain day, it's there!

Hardesty is dependable in another sense, too. Their products are always uniform. There's not any last-minute juggling of formulas because of a change in a fatty acid,—not if it's a *Hardesty* fatty acid. No customer kick-backs, either, because soaps, plastics and textiles manufactured and processed with Hardesty products are of identical quality.

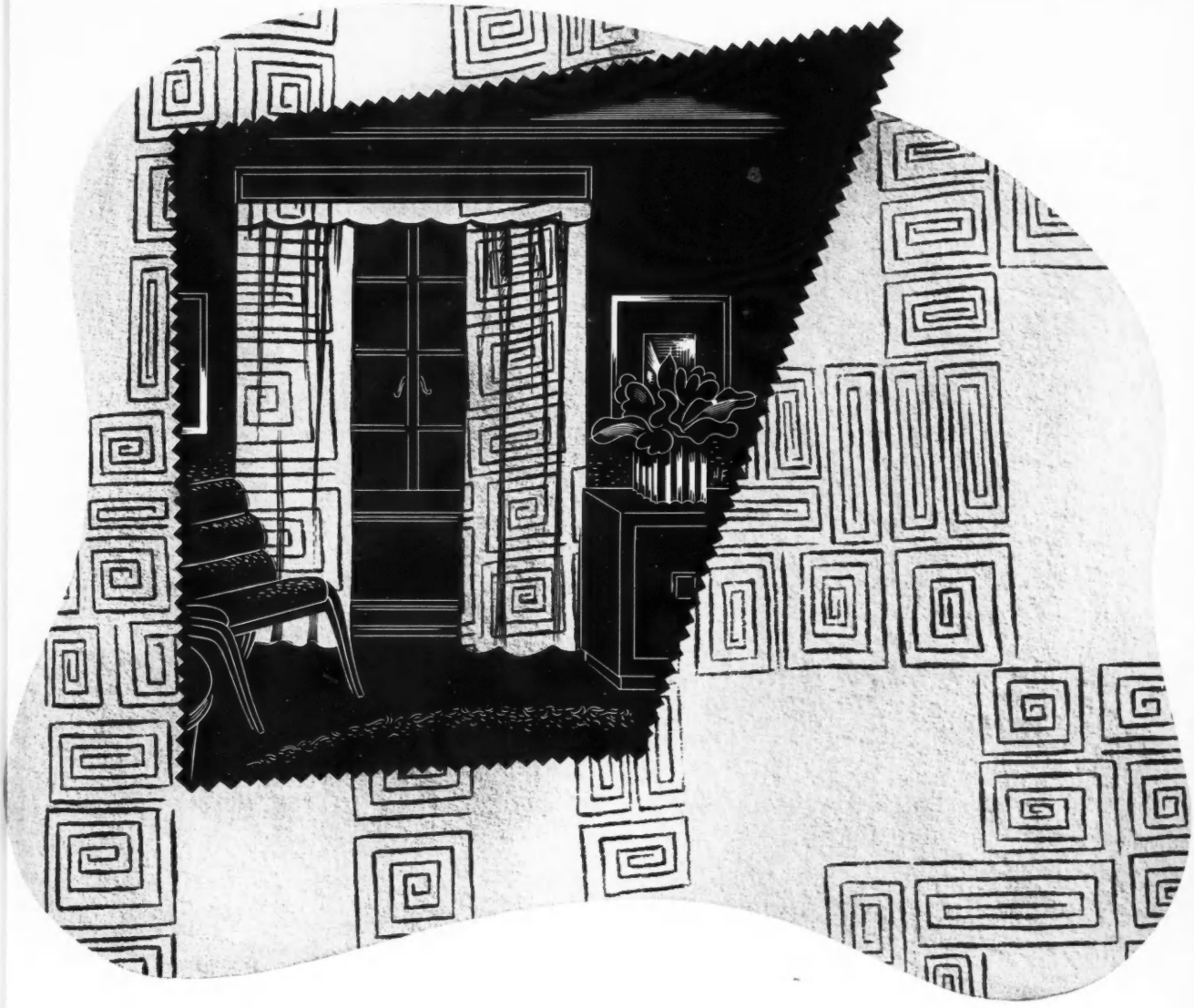
The Hardesty Way is the Easy Way. Don't miss Hardesty . . . because you *can't* miss *with* Hardesty."

Red Oil Glycerine Stearic Acid White Oleine Stearine Pitch Hydrogenated Fatty Acids Animal and Vegetable Distilled Fatty Acids.

41 EAST 42nd STREET NEW YORK 17, NEW YORK

Factories: Dover, Ohio—Los Angeles, California—Toronto, Can.

W·C·
HARDESTY
COMPANY



HOW WOULD YOU PRINT THIS PATTERN ON VELVET?

And how would you hold the soft, deep pile of the fabric and protect its hand?

To print this Shantung design by Vera for F. Schumacher and Company, Printex Corporation of America used the new, low-crock Aridye® Black FK, cut 1:5 with Aridye clear 6211-2.

By using an Aridye Pigment Color, Printex wisely avoided the risks and additional expense found in the ageing, steaming, soaping or other after-treatments that conventional dyes require.

The dyed fabric was merely screen printed, air dried and heat cured—a 1, 2, 3 process that was easier, quicker and safer and resulted in no impairment of the velvet's pile and hand.

This high-style, high-quality decorator fabric is an outstanding example of the reason why leading screen and roller printers use Aridye Pigment Colors for unusual as well as everyday printing jobs.

CHECK THESE EIGHT ADVANTAGES

Sharpness of Mark • Exceptional Fastness to Sunlight
Uniformity of Shade • Fastness to Washing • Economy
Bright Colors • Ease of Application • No Impairment of Hand

Aridye *Pigment Co.*

INTERCHEMICAL CORPORATION • TEXTILE COLORS DIVISION • FAIR LAWN, N. J. • ROCK HILL, S. C. • PROVIDENCE, R. I.

ONE COLOR FOR

INTERCHEM ACETATE
RUBINE 3B

Interchem® Acetate Rubine 3B gives you these advantages:

Retains brilliance when toned down to light pink shades.

No specking, no tarring—hence fewer redyes, fewer seconds.

Suitable for both dyeing and application or discharge printing.

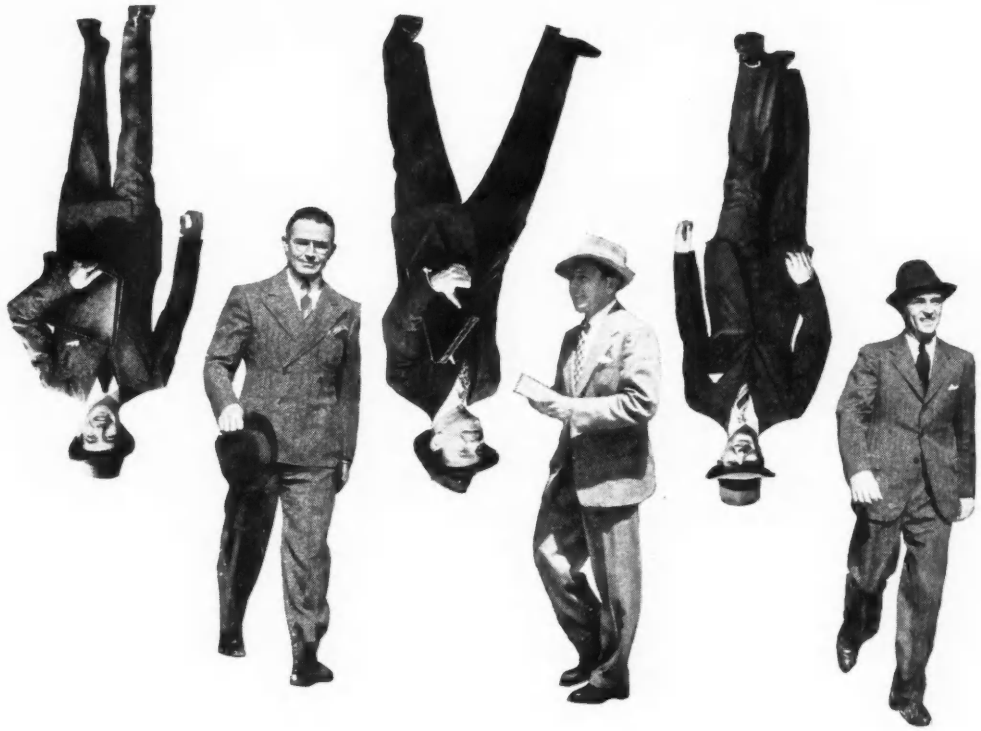
On acetate rayon, Interchem Acetate Rubine 3B produces a bright bluish red shade. On nylon, the shade is much bluer.

When pasted with water, Interchem Acetate Rubine 3B disperses rapidly and completely.

For complete technical information and sample write to:

Interchemical Corporation—Textile Colors Division,
Box 357, Fair Lawn, New Jersey.

Interchem Dyes
TRADE MARK



it all depends on your point of view

When our customers think of STEIN-HALL some see laboratory smocks,
microscopes and rubber gloves...and some see pin-stripe suits,
brief cases and order pads.

The astigmatism needn't be corrected though,
for STEIN-HALL actually is all of them
...and at the same time.

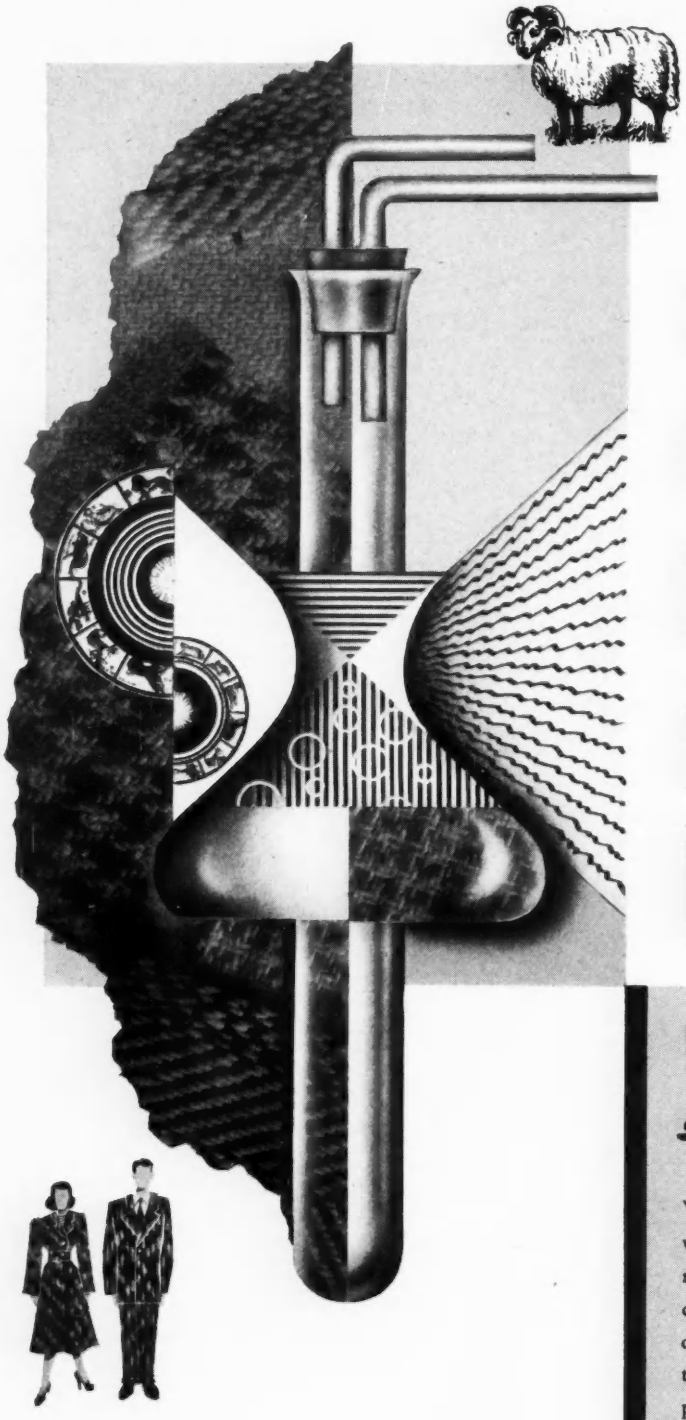
In our 82-year-old TEXTILE SALES DEPARTMENT...
the laboratory equipment is responsible for studying,
testing and improving our products...
the salesman garb for telling *you* about them.

For 82 years now, we've been in perfect focus...
which is why the name STEIN-HALL
is among the most honored in the world.

Write for Quotations, Samples and Technical Information

STEIN SH HALL

285 MADISON AVENUE, NEW YORK 17, N. Y.



a new fabric is born

BUT...

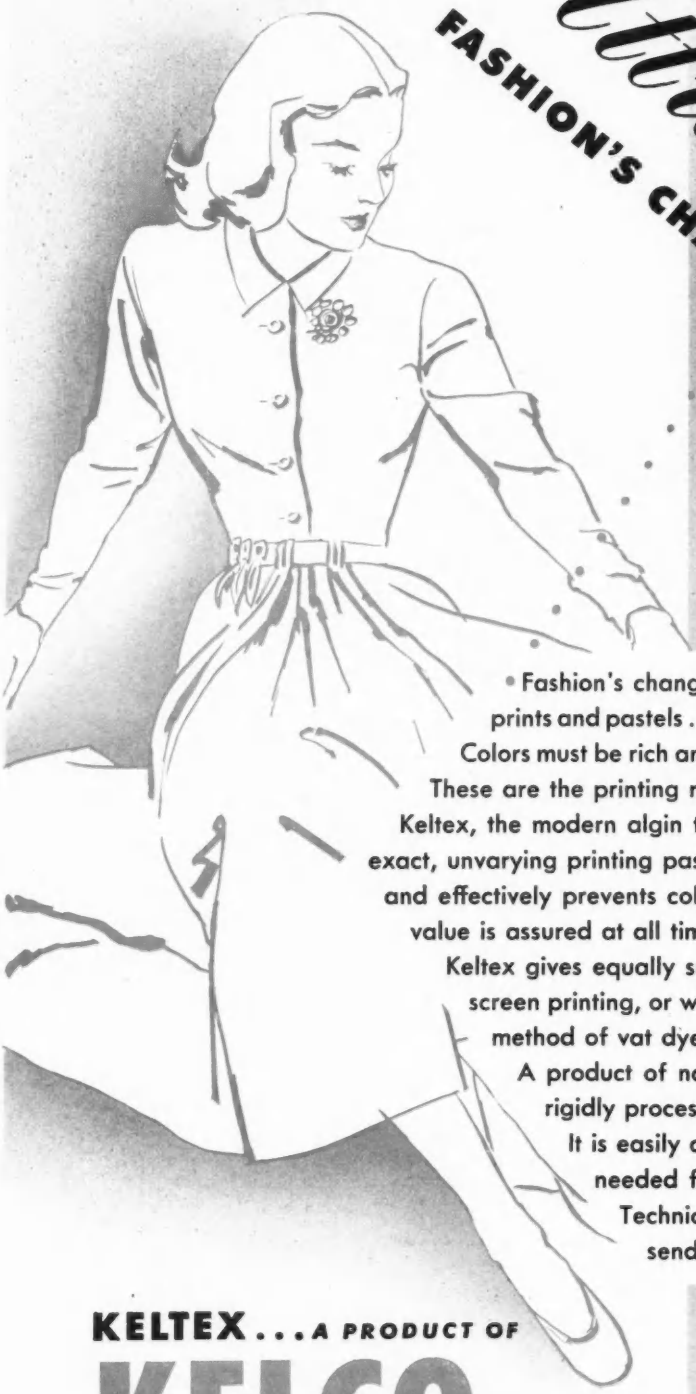
How Will it Scour?

With a yard of your fabric in the grease we are in a position through our research laboratory to give you a complete detergency analysis. Join our many customers who are enjoying this service that offers you the most economical procedure for scouring your fabrics.

A Watson-Park representative will be glad to discuss your problems with you, or if you wish, just mail us the material you desire analyzed.

WATSON-PARK CO.
261 FRANKLIN ST. BOSTON, MASS.
FACTORY · LOWELL JUNCTION · MASS.

Attuned TO FASHION'S CHANGING MOOD



• Fashion's changing mood calls for new, exciting prints and pastels . . . keyed to the styling of the New Look. Colors must be rich and brilliant; patterns sharp and clear. These are the printing results you get when you use Keltex, the modern algin thickening agent. Keltex provides exact, unvarying printing paste viscosity — superior penetration — and effectively prevents color migration. True, even color value is assured at all times.

Keltex gives equally superior results in machine and screen printing, or when used in the pad pigment method of vat dyeing.

A product of nature, Keltex is super-refined and rigidly processed for consistent uniformity. It is easily applied and only a light wash is needed for complete removal. Our Technical Department will be pleased to send you full information on request.

KELTEX . . . A PRODUCT OF

KELCO COMPANY

KELTEX REFINED ALGIN PRODUCT

20 N. Wacker Drive
CHICAGO—6

31 Nassau Street
NEW YORK—5

530 W. Sixth Street
LOS ANGELES—14

Cable Address: **KELCOALGIN**—New York

Wherever Stability Against Hardness, Electrolytes and Anionic or Cationic Surface-Active Agents Is Wanted . . .

NEUTRONYX 330

Non-Ionic Detergent Emulsifier and Dispersant

NEUTRONYX 330 is a non-ionic surface-active agent with unusually effective emulsifying and dispersing action. It is outstanding in its compatibility with hard water, electrolytes and anionic or cationic surface-active agents.

It gives highly satisfactory detergent effects due to its solubilizing and emulsifying action on oils and greases, and its ability to prevent redeposition of soil on fabrics. It is readily miscible not only with water, but with organic solvents.

PERFORMANCE

NEUTRONYX 330 is a good wetting agent in warm water, with a Draves test of 27 seconds in 0.5% solution at 60°C. This 0.5% solution shows a DuNouy tensiometer reading of 34.5 dynes at 25°C. A 0.1% solution with 0.25% TSPP shows a detergency of 22.8%. Foaming tests on a 0.5% solution show 26 cc. immediate foam level and a 11.5 cc. level after 5 minutes.

APPLICATIONS

NEUTRONYX 330 is widely used as an auxiliary detergent in hard water conditions. It acts as an excellent dispersing and solubilizing agent for acetate colors. In acid dyeing of wool, it is a good leveling agent. It makes a most effective dispersing agent for pigments in organic vehicles.

NEUTRONYX 330 is a highly satisfactory scouring assistant for rayon and acetate, and finds a specialized use as an assistant in chlorination shrink proofing of wool.

If you have never tried Neutronyx 330 on any of these applications applying to your operations, we'll be glad to supply a sample for test.

New

Onyx Technical Bulletin

Just off the press is a new 6-page bulletin covering all up-to-date and pertinent data on The Onyxsans . . . the cationic surface-active softening agents with permanent effects on cotton, rayon, acetate and bemberg. If you do any softening, write for a copy of this informative bulletin.

onyx CHEMICALS FOR DYEING • FINISHING • PRINTING

ONYX OIL & CHEMICAL COMPANY

JERSEY CITY 2, N. J.

CHICAGO • PROVIDENCE • CHARLOTTE • ATLANTA • LOS ANGELES

In Canada: Onyx Oil & Chemical Co., Ltd. Montreal, Toronto, St. Johns, Que.

For Export: Onyx International Jersey City 2, N. J.

The dependable, rapid and economical de-sizing agent for cottons, rayons and mixed goods. Applicable over a wide range of processes, temperatures and speeds.

HAS PROVED PARTICULARLY SUITABLE FOR CONTINUOUS DE-SIZING

WALLERSTEIN COMPANY, INC. • 180 MADISON AVENUE • NEW YORK 16, N. Y.

Brightness and Economy are Characteristics of

Pharmasol* Golden Yellow N

PHARMASOL Golden Yellow N produces clear, bright, fast and economical golden yellow shades when printed on cottons or rayons.

When mixed with Pharmasol Red RN, a complete range of Gold Shades can be obtained.

PHARMASOLS are solutions of stabilized azoic dyes and adjusted to the most practical concentration which can be easily applied with a maximum of efficiency.

PHARMASOLS solve the problem of troublesome dissolving and the uncertainties thereof—and as there is no decomposition there can be no loss of material or value.

*Reg. U. S. Pat. Off.

Wide Range of use is Big Feature of

Indigosol* Golden Yellow IGK

THE present price of Indigosol Golden Yellow IGK makes possible the use of this very fast Indigosol for economical dyeing and printing operations.

In combination with Indigosol Green IBA, very fast green shades are now available to the printer and dyer for the first time at a very reasonable cost.

An excellent printing color on cotton and rayon, it is also of great interest to the dyer of cotton, rayon and wool.

In ease of application, the perfectly level shades obtained, and the unusually excellent penetration of heavy goods makes the entire line of INDIGOSOLS especially valuable to the fast color dyer or printer.

*Reg. U. S. Pat. Off.

CARBIC COLOR AND CHEMICAL CO., INC.

451-453 Washington Street, New York City

BRANCHES:
PHILADELPHIA
PROVIDENCE HAMILTON, ONT.
CHARLOTTE, N. C.

IMPORTERS OF THE MANUFACTURES OF
DURAND & HUGUENIN S. A.
BASLE, SWITZERLAND

EXCLUSIVE DISTRIBUTORS OF
PHARMASOLS
PHARMOLS
PHARMACINES

Representative: Los Angeles (Hathaway Allied Products)

AMERICAN

DYESTUFF REPORTER

LOUIS A. OLNEY, D.Sc.
Directing Editor

NORMAN A. JOHNSON, B.T.C.
Managing Editor

MYRON D. REESER
Advertising Manager

GRACE B. BURTON
Production Manager

M. H. MORGAN
Circulation Manager

Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

•

Published every other Monday by
HOWES PUBLISHING COMPANY, INC.
One Madison Avenue, New York 10, N. Y.

A. P. HOWES
President

C. R. HOWES
Vice President

H. F. CRAWFORD
Treasurer

M. D. REESER
Secretary

C. ESSENBREIS
Asst. Secretary

•

Also Publishers of
KNIT GOODS WEEKLY
TEXTILE COLORIST
AND CONVERTER
HOSIERY MERCHANDISING

•

March 8, 1948

VOLUME 37 NUMBER 5

Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Proceedings of the American Association of Textile Chemists and Colorists

160th Council Meeting.....P144

Meeting, New York Section.....P146

Meeting of the Southeastern Section.....P146

Winter Meeting, Piedmont Section.....P146

Meeting, PTI Student Chapter.....P146

April Meeting, South Central Section.....P146

152nd and 153rd Meetings of the Research Committee P147

Membership Applications P148

New Test Fabrics.....P148

Correction P148

Intersectional Contest

The Application of Chemical Controls to Acid Dyeing P149
Philadelphia Section

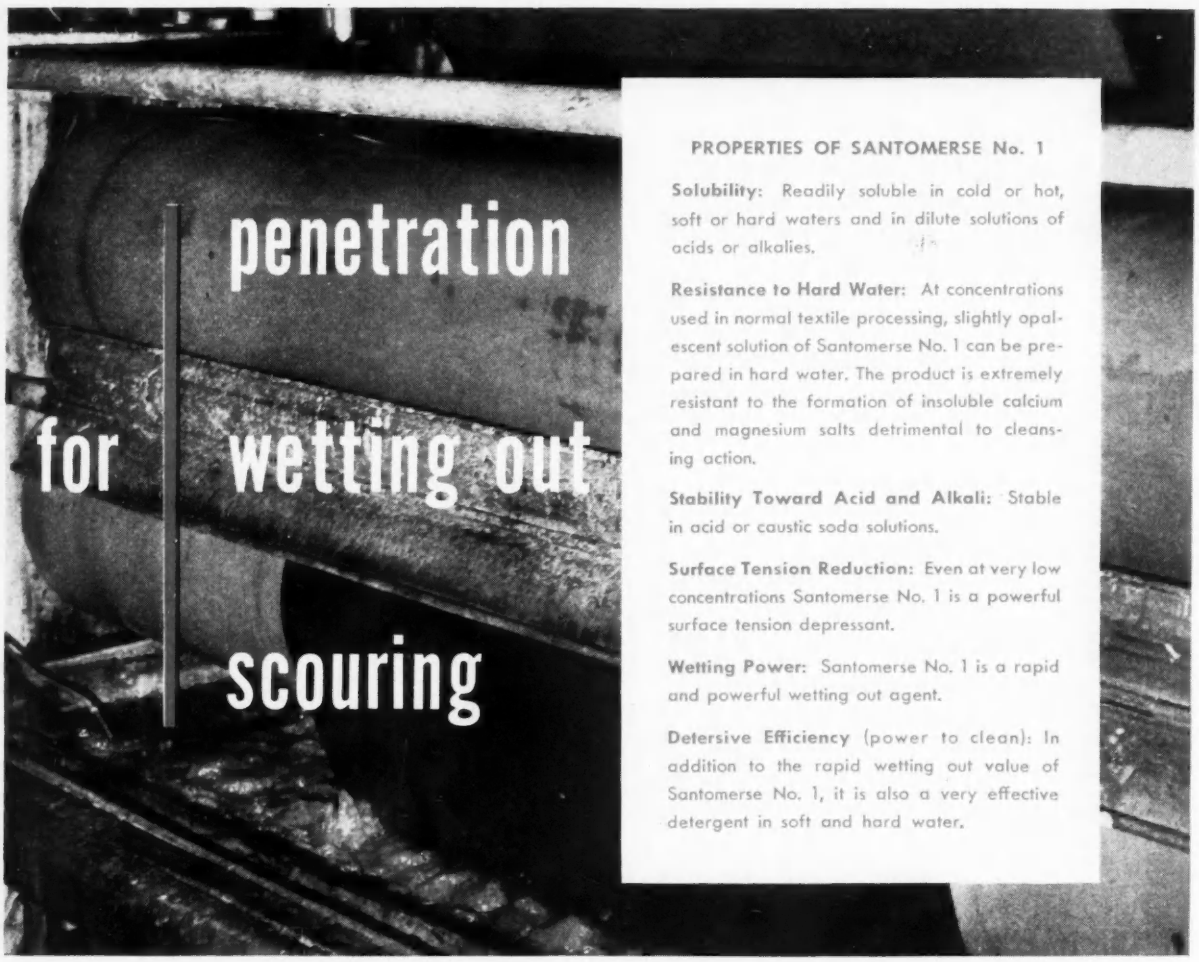
Notice to Authors of Papers.....P165

Fundamental Research Group Meeting
Studies of Nylon Dyeing: Effect of Dyeing Procedures P166
Louis I. Fidell, George L. Royer and Henry E. Millson

Calendar P182

Employment Register P182

Copyright, 1948, Howes Publishing Co., Inc.



PROPERTIES OF SANTOMERSE No. 1

Solubility: Readily soluble in cold or hot, soft or hard waters and in dilute solutions of acids or alkalies.

Resistance to Hard Water: At concentrations used in normal textile processing, slightly opalescent solution of Santomerse No. 1 can be prepared in hard water. The product is extremely resistant to the formation of insoluble calcium and magnesium salts detrimental to cleansing action.

Stability Toward Acid and Alkali: Stable in acid or caustic soda solutions.

Surface Tension Reduction: Even at very low concentrations Santomerse No. 1 is a powerful surface tension depressant.

Wetting Power: Santomerse No. 1 is a rapid and powerful wetting out agent.

Detersive Efficiency (power to clean): In addition to the rapid wetting out value of Santomerse No. 1, it is also a very effective detergent in soft and hard water.

Improved SANTOMERSE No. 1

Improved Santomerse No. 1 is particularly valuable in textile processing because it combines three important properties in one agent . . . penetration, wetting out and scouring (cleansing).

As a leveling agent for dyeing operations, Santomerse No. 1 can be used prior to dyeing to wet out thoroughly and to assist penetration, or it can be added directly to the dye bath. Either method of application will result in a quicker, more complete operation because of the effective protective surface action exerted by Santomerse No. 1.

The high detergency and easy rinsing of Santomerse No. 1 make it an ideal scouring agent for all fibres. Its neutral character prevents fibre injury and, since Santomerse No. 1 is chemically stable, it may be used in either acid or alkaline operations.

Valuable application and technical data on Santomerse No. 1 for the textile field are available in Application Data Bulletin No. P-118. Write for your copy or mail in the convenient coupon. MONSANTO CHEMICAL COMPANY, Phosphate Division, 1700 South Second St., St. Louis 4, Missouri.

District Sales Offices: New York, Philadelphia, Chicago, Boston, Detroit, Cleveland, Cincinnati, Charlotte, Birmingham, Los Angeles, San Francisco, Seattle. In Canada: Monsanto (Canada) Limited, Montreal.

Santomerse: Reg. U. S. Pat. Off.

MONSANTO CHEMICALS

MONSANTO CHEMICAL COMPANY ADP-3
Phosphate Division
1700 South Second Street, St. Louis 4, Missouri

Please send me a copy of the Santomerse No. 1 Application Data Bulletin.

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

SERVING INDUSTRY . . . WHICH SERVES MANKIND

Proceedings of the
American Association of Textile Chemists and Colorists

Copyright, 1948, American Association of Textile Chemists and Colorists

MARCH 8, 1948

National Officers of the Association

President
HENRY F. HERRMANN
General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y.

Vice-Presidents
C. NORRIS RABOLD
Union Bleachery, Greenville, S. C.
JOHN N. DALTON
Pacific Mills, Lawrence, Mass.

Treasurer
WILLIAM R. MOORHOUSE
National Aniline Division, Allied Chemical & Dye Corp., 150 Causeway Street, Boston 14, Mass.

Secretary
HAROLD C. CHAPIN
Lowell Textile Institute, Lowell, Mass.

President Emeritus
LOUIS A. OLNEY
Lowell Textile Institute, Lowell, Mass.

Chairman of the Research Committee
J. ROBERT BONNAR
General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y.

Director of Research
HAROLD W. STIEGLER
Lowell Textile Institute, Lowell, Mass.

COUNCILORS
Representing Sections

Rhode Island: GEORGE H. WOOD, JR., HAROLD B. STURTEVANT, RALPH F. CULVER.
Philadelphia: CURT R. BAERINGER, LLOYD O. KOONS, ARTHUR W. ETCHELLS, WALTER F. FANCOURT, 3rd, PERCIVAL THEEL.
New York: GEORGE L. BAXTER, EMMETT J. DRISCOLL, WINN W. CHASE, WILLIAM A. HOLST, FRANCIS S. RICHARDSON, CHARLES W. DORN.
Northern New England: WALTER J. HAMBURGER, DAVID X. KLEIN, C. WENDALL LEVER.
Piedmont: SIDNEY M. CONE, WYSS L. BARKER, LELAND G. ATKINS.
Southeastern: WILLIAM B. GRIFFIN.
South Central: JACK ANDERSON.
Mid-West: ERIC W. CAMP, SAMUEL KLEIN.

Past Presidents

ELVIN H. KILLHEFFER, P. J. WOOD, WILLIAM H. CADY, ALBAN EAVENSON, CARL Z. DRAVES, THOMAS R. SMITH, WILLIAM D. APPEL.

Standing Committees of the Council and their Chairmen

Executive Committee on Research
J. Robert Bonnar, Chairman

Publicity
Winn W. Chase, Chairman

Conventions
Kenneth H. Barnard, Chairman

Appropriations
William R. Moorhouse, Chairman

Constitution and By Laws
Harold C. Chapin, Chairman

Membership and Local Sections
John N. Dalton, Chairman

Corporate Membership
Emmett J. Driscoll, Chairman

Publications
Louis A. Olney, Chairman

Technical Programs
Miles A. Dahlen, Chairman

Local Sections and their Officers

Northern New England Section

Chairman
George O. Linberg, Monsanto Chemical Co., 140 Federal Street, Boston 5, Mass.
Secretary
Azel W. Mack, Dexter Chemical Corp., 581 Boylston Street, Boston 16, Mass.
Vice-Chairman: Frank J. O'Neil
Treasurer: Martin H. Gurley, Jr.

Rhode Island Section

Chairman
Raymond W. Jacoby, Ciba Co., Inc., 61 Peck Street, Providence 1, R. I.
Secretary
Emory A. Richards, Airedale Worsted Mills, Inc., 1 Main Street, Woonsocket, R. I.
Vice-Chairman: Robert W. Joerger
Treasurer: Robert R. Farwell

New York Section

Chairman
Herman E. Hager, General Dyestuff Corp., 435 Hudson Street, New York 14, N. Y.
Secretary
Norman A. Johnson, American Dyestuff Reporter One Madison Ave., New York 10, N. Y.
Vice-Chairman: Charles W. Dorn
Treasurer: John H. Hennessey

Philadelphia Section

Chairman
Arthur M. Gordon, Martin Fabrics Corp., Allegheny Ave. and Boudinot St., Philadelphia 34, Pa.
Secretary
Thomas H. Hart, Hart Products Corp., P.O. Box 5020, Philadelphia 11, Pa.
Vice-Chairman: James Dixon
Treasurer: A. E. Raimo

Piedmont Section

Chairman
John B. Neely, Burlington Mills, Burlington, N. C.
Secretary
Robert H. Smith, Melrose Hosiery Mills, High Point, N. C.
Vice-Chairman: Pelham Eugene Smith
Treasurer: Edwin A. Briggs

South Central Section

Chairman
Raymond B. Seymour, Industrial Research Institute, University of Chattanooga, Chattanooga 3, Tenn.
Secretary
Howard P. Loveless, Crystal Springs Bleachery, Chickamauga, Ga.
Vice-Chairman: J. Albert Crumley
Treasurer: Charles Gordon

Mid-West Section

Chairman
Joseph H. Jones, Phoenix Dye Works, 1963 Southport Ave., Chicago 14, Ill.
Secretary
William Boyd, Jr., Ciba Co., Inc., 325 W. Huron St., Chicago 10, Ill.
Vice-Chairman: Elliott Morrill
Treasurer: Edward Larson

Southeastern Section

Chairman
C. Russell Gill, Southern Sizing Co., P.O. Box 167, Atlanta, Ga.
Secretary
S. Jack Davis, Callaway Mills, LaGrange, Ga.
Vice-Chairman: Howard M. Waddle
Treasurer: W. F. Crayton

Student Chapters

Lowell Textile Institute
North Carolina State College
Philadelphia Textile Institute
New Bedford Textile Institute
Georgia School of Technology
Clemson College

Members should notify the Secretary immediately of all address changes

160th Council Meeting

THE Council held its 160th meeting in the Downtown Athletic Club, New York, N. Y., on Friday morning, Jan. 9, 1948. Present were President Henry F. Herrmann, presiding; John N. Dalton, Vice President; William R. Moorhouse, Treasurer; J. Robert Bonnar, Chairman of the Research Committee; William D. Appel, William H. Cady, Carl Z. Draves, Thomas R. Smith and P. J. Wood, Past Presidents; David X. Klein, C. Wendell Lever and George O. Linberg representing Northern New England; Raymond W. Jacoby representing Rhode Island; Winn W. Chase, Charles W. Dorn, Emmett J. Driscoll, William A. Holst and Harold H. Taylor representing New York; Curt R. Baeringer, Arthur W. Etchells, Walter F. Fancourt 3rd, Lloyd O. Koons and Percival Theel representing Philadelphia; Wyss L. Barker, V. B. Holland and R. Hobart Souther representing Piedmont; William B. Griffin representing Southeast; Kenneth H. Barnard, Chairman of the Convention Committee; Miles A. Dahlen, Chairman of the Technical Program Committee; Patrick J. Kennedy, Chairman of the Intersectional Contest Committee; Leonard S. Little, Chairman of the President's Policy Committee; Douglas C. Newman, Manager of the Augusta Convention; and Horald C. Chapin, Secretary.

The Secretary's report on the 159th Council meeting and financial report of Dec. 31, 1947, and the Treasurer's report of Jan. 2, 1946, were accepted.

Henry F. Herrmann was reported elected President, and John N. Dalton and C. Norris Rabold Vice Presidents. J. Robert Bonnar was elected Chairman of the Research Committee for three years beginning Jan. 1, 1948; and Miles A. Dahlen and Percival Theel, members of the Executive Committee on Research. Committees are as follows—

Executive Committee on Research
J. R. Bonnar, *Chairman*
H. F. Herrmann, ex officio
W. D. Appel
S. L. Hayes
M. A. Dahlen
P. Theel

Appropriations
W. R. Moorhouse, *Chairman*
H. C. Chapin
C. Z. Draves
L. A. Olney
P. J. Wood

Publications
L. A. Olney, *Chairman*
W. H. Cady
H. C. Chapin
W. W. Chase
C. Z. Draves
N. A. Johnson
R. W. Philip

Conventions
K. H. Barnard, *Chairman*
B. C. Bond
E. J. Driscoll
S. L. Hayes
G. O. Linberg
R. W. Philip
E. F. Smith

Corporate Membership
E. J. Driscoll, *Chairman*
F. L. Bume
S. M. Cone
M. H. Gurley, Jr.
K. J. Broden
A. K. Haynes
S. Klein
H. A. Rodgers
F. C. Scholler

Publicity
W. W. Chase, *Chairman*
W. D. Appel
K. H. Barnard
C. W. Bendigo
G. B. Chabot, Jr.
H. F. Herrmann
N. A. Johnson
H. E. Millson
A. J. Nelson
L. A. Olney
A. E. Raimo
J. C. Shore
A. R. Thompson
H. W. Waddle
H. E. Wieland

Membership & Local Sections
C. N. Rabold, *Chairman*
H. C. Chapin
J. N. Dalton

Constitution & Bylaws
H. C. Chapin, *Chairman*
C. Z. Draves
W. R. Moorhouse

Technical Program
M. A. Dahlen, *Chairman*
K. H. Barnard
F. Dannerth
H. E. Hager
W. J. Hamburger
R. W. Jacoby
H. Boxser
S. J. Davis
V. B. Holland
R. B. Seymour

Intersectional Contest
P. J. Kennedy, *Chairman*

President's Policy Committee
L. S. Little, *Chairman*
W. D. Appel
H. C. Chapin
C. Z. Draves
E. H. Killheffer
W. R. Moorhouse
T. R. Smith
P. J. Wood

Representative on Inter-Society Color Council for Textile Research
C. Z. Draves; alternate, W. A. Holst, Jr.

Committees on Colour Index and *Student Medal* remain unchanged.

For the Research Committee Mr. Bonnar reported reorganization with changes in personnel, new committees on Snag Resistance and Chlorine Retention, and organization of Sectional research chairmen into a committee to promote cooperation. From answers to the Research Questionnaire a list of projects has been prepared for distribution. Further work has been suggested by Intersectional Contest papers. Chairmen of sub-committees are instructed not to assume prerogatives of the general Chairman or Council in contracting for manufacture or selling prices of supplies developed by the committees. Format of test methods is being revised for the 1948 Year Book.

The Flammability Test, formerly voted and reported to the National Bureau of Standards as an AATCC standard, was reduced to status of a tentative method pending further study.

On Publicity, Mr. Chase showed excellent results from the Chicago convention; but asked more help from Sections, not only in local publicity but in promptly sending him abstracts of technical papers from their meetings for release through his established channels.

For the Appropriations Committee Mr. Moorhouse recommended additions to the budget, which were noted, for more clerical assistance to the Secretary, and for the following purpose:

"To the end that Sections may improve their meetings through better speakers, and the Reporter through better original papers turned in for publication, the

SECRETARY'S FINANCIAL REPORT—DECEMBER 31, 1947

	Applications	*Dues, regular & reinstate*	*Dues, Corporate & Sustaining*	*Miscellaneous*	*Totals*
Received and transmitted to Treasurer,					
August 1, to October 17, 1947....	$759.50	$1,980.50	$70.00	$5,079.91	$7,889.91
October 17 to December 31, 1947	927.00	24,002.00	21,935.00	12,834.56*	59,698.56
Total in fiscal year to date.....	1,686.50	25,982.50	22,005.00	17,914.47	67,588.47
Leaving deposited by Treasurer with Secretary, general					2,000.00
Leaving deposited by Treasurer with Secretary, for salaries and miscellaneous payments					4,293.85

Miscellaneous items		*
Dividends		$144.80
Mid-west Section, repayment, convention loan		1,000.00
Mid-west Section, registrations, net		636.90
Quartermaster contract		8,220.73
Launderometer royalties		170.00
Reporters		70.15
Year Books		639.50
Analytical Methods		11.00
Crockmeters		510.50
Crock cloth		218.25
Moth cloth		76.25
Water test apparatus		88.50
Dyed standards		94.00
Knitted tubing		28.00
Buttons		3.50
Royalties, flammability tester		24.00
Color transfer charts		50.00
Gas fading units		65.50
Colour Index		784.00
Reprints		2.50
		12838.08
Bank charges		3.52
		$12,834.56

Council appropriates, from general funds, for the use of each Section, in the year begun Jan. 1, 1948, $25. times the number of technical meetings of that Section, to be paid by the Treasurer of the Association directly to the speakers for traveling expenses, in accordance with statements approved by the Secretary of the Section and submitted to the Secretary of the Association."

For Professor Lindsay's Committee on Student Medals, Mr. Smith presented a report recommending annual awards in designated institutions of learning, which was approved and referred back to the committee for further study.

Plans for the convention in Augusta, Georgia, Oct. 21 to 23, under auspices of the three Southern Sections, including arrangements for a special train from New York, were discussed by Mr. Newman, local Chairman, Mr. Barnard, and Mr. Kennedy. Suggestions for a convention next following that of October, 1949, in Atlantic City, were referred to the Rhode Island and Northern New England Sections for further consideration.

On Publications, the Secretary reported for Dr. Olney that a Board of Editors for Proceedings would give first attention to papers from Sections, for the present accepting convention papers for publication essentially as given; that rules drawn by Dr. Draves, after approval by Dr. Dahlen, would be published for guidance of authors; and that experience with the coming monograph on Analytical Methods might be employed in publication of other monographs.

On the new Colour Index Mr. Cady reported reluctance of the British Society of Dyers and Colourists to share editorial authority equally with our Association. In its insistence on such equality our committee was voted the confidence of the Council. A few copies of the old Colour Index are available from the AATCC Secretary at $28.

A study of the remuneration of textile chemists was proposed by D. X. Klein, and referred to the President with power to appoint a special committee.

For the Committee on Membership and Local Sections, in consultation with W. F. Fancourt 3rd and R. W. Joerger, Mr. Dalton recommended authorization of a Western New England Section in that part of New England lying along the Connecticut river and to west of it. This was voted, and Dr. J. Edward Lynn was appointed Secretary *pro tem* of the meeting to organize.

The next two Council meetings will be in New York, on April 2, and on June 11, in week of Textile Exhibition.

Corporate membership renewals for 1948 were reported normal; but increased effort in all Sections was urged by Mr. Driscoll to replace inevitable losses and meet larger financial requirements. Elected to Corporate membership were the Girdler Corporation, Perkins Soap Co., and U. S. Process Corporation. Each of the following was elected to the class of membership specified, as of thirty days from publication of application, provided no objection be received meanwhile by the Secretary.

Senior

D. F. Allen
W. J. Barnes
M. Berger
R. C. Born
H. C. Brooke
A. E. Brown
R. L. Brown
F. J. Buckley
K. Burrow
Y-L Chiu
T. G. Christodoulo
H. Chwatt
J. A. Clark
C. S. Clutz
J. J. Connorton
J. J. Curry
A. R. DeCesare
T. G. de Haan
F. J. De Maria
H. I. Eisenman
E. J. Fitzgerald, Jr.
J. A. Gaino
E. J. Gom
C. Harmon
J. R. Harris
W. E. Harris, Jr.
W. M. Hemphill
W. M. Housch
J. Y. Izumi
C. W. Jones
J. A. Kelly
H. G. Kennedy
K. S. Khandheria
R. B. Killingsworth
G. H. Klingberg
E. J. Knott
E. M. Kondrath
J. E. Laflamme
A. W. Lanner
W. S. Lawrence
H. W. Lindley
N. A. Long
W. G. Luqueer
H. J. McDermott
N. J. Mohoruk
J. G. A. Mulder
J. N. Murphy
E. Neumann
F. Neustaetter
B. S. Nicholson
N. K. Patel
F. E. Petzel
F. M. Pickren
L. S. Potsdamer
M. W. Ramsey
S. Redfern
B. L. Rhodes
G. Rock
J. F. Roeloffzen
E. H. Rossin
D. Scialla
U. A. Serrander
E. P. Sherman
N. H. Sherow
O. W. Simmons
M. S. Simon
P. S. Smith
G. Thomson
F. J. Tuohey
L. B. Volk
F. C. Wedler
J. A. Whitney
H. J. Wilkinson
J. R. Williams, Jr.
W. W. Williams
R. E. Wolfrom
R. C. Wood

Junior

R. F. Aurich
C. A. Bell
O. G. Boyd
J. C. Busby, Jr.
G. H. Fine
T. Fine
W. J. Flanagan
L. Hochstein
J. M. Leach
V. D. Lyon
H. G. Mathews, Jr.
D. K. Miller
G. A. Moos
E. Pavlich
M. L. Segal
M. J. Smith
R. A. Wilton
W. J. Wyskoczka

Associate

C. H. Bronson
J. J. Burke, Jr.
C. J. Chainer
K. G. Dustin
C. W. Farrell
R. R. Finn
I. H. Freed
O. Gansert
J. J. Gillespie
S. O. Gran
L. T. Jonsson
M. J. Lameire
B. Lockert
H. Mayer
L. G. McClay
S. McDermott
W. J. McLane
G. M. McNulty
K. W. Newman
J. M. Perri
M. A. Seiler
W. E. Sohl
M. L. Veze
H. Weiss

Student

R. P. Barber	Z. A. Kotob
A. J. Berube	R. J. LeBrun
W. E. Bill	R. P. Lehman
P. V. Boudreau	G. M. Lemire
M. B. Boyce	A. M. Levenson
B. T. Bridgers	C. J. Limerick
J. A. Brown	S-W. Loh
N. M. Brunelle	D. M. McAllister
L. S. Chang	D. A. McCarron
P. C. Chao	J. J. Murphy
M. Charatz	M. Murphy
E. Cherowbrier	J. C. Nelson
T. R. Commerford	C. Newland
L. C. Connors	R. A. Normandin
J. A. Desjardins	J. F. O'Donnell
S. V. Dubiel	C. Pappas
T. J. Fay	H. B. Peterson
M. Fishman	J. Poulton, Jr.
L. P. Gaidis	W. C. Privette
L. I. Gibson	L. R. Rochefort
L. V. Gordon	H. Rogers
A. P. Gouveia	W. G. Silva
J. L. Gregg	R. K. Silveira
S. J. Grochmal	F. M. Sizemore, Jr.
P. A. Gruber	H. J. Smaha
C. A. Harvey	R. I. Strobel
S. Helfand	V. C. Thompson
S. P. Hersh	C. R. Trommer
F. M. Hinds	J. E. Viera
E. T. Hord	H. F. Williams
J. C. Hutchinson	C. J. Wolhar
E. L. Kelley	E. B. Wood
F. R. Kern	

The following were transferred from other classifications to Senior Membership:

P. H. David	H. F. Metzler, Jr.
J. Falcon	W. H. Moon
E. K. Genger	I. Peters
A. E. Gervais	R. E. Rettew
C. J. Haas	A. H. Roberts
M. Hacker	H. J. Rotters
D. O. Hamer, Jr.	M. O. Shows
J. Hilton, II	S. P. Sweatt
M. Kramer	H. R. Walker, Jr.
A. A. Margolin	E. Zerner

Respectfully submitted,
H. C. CHAPIN, *Secretary*

—♦ ♦—

Meeting, New York Section

A MEETING of the New York Section was held on January 23rd at the Hotel New Yorker, New York City. An informal dinner preceded the meeting.

The first speaker on the technical program was Richard E. Sumner, Manager of the Textile Resin Department of Calco Chemical Division, American Cyanamid Company, who discussed "Chemical Finishes to Improve Use and Wear Qualities of Fabrics". In conjunction with Mr. Sumner's paper there was shown a new color film "It's All in the Finish" which stresses the importance to the consumer of the new functional finishes for textiles. In addition there was an exhibit of a number of fabrics to illustrate the uses of the various chemical finishes.

Richard E. Sumner speaking at the January 23rd meeting of the New York Section. The other speaker, M. T. Fleming, is at the rear and Dr. Herman E. Hager, Chairman of the Section, is at the right in the photo.

The second paper on the program was "Textile Drying" by M. T. Fleming, Sales and Development Engineer of Proctor & Schwartz, Inc. Mr. Fleming discussed both theoretical and practical aspects of this subject and his address was illustrated by a number of slides.

The attendance was 332.

Respectfully Submitted,
Norman A. Johnson, *Secretary.*

—♦ ♦—

Meeting of the Southeastern Section

ON December 6th, 1947, the Southeastern Section held a meeting and dinner in the Ansley Hotel, Atlanta, Georgia, with 67 present. Officers for the year 1948 were elected. Thomas R. Smith, Past President of the Association and Manager of the Yarn Dyeing Department of Wiscassett Mills Co., Albemarle, N. C., presented a "Review of the Textile Reports of German Technical Developments".

—♦ ♦—

Winter Meeting, Piedmont Section

THE Winter Meeting of the Piedmont Section was held at the Poinsett Hotel, Greenville, S. C., Saturday, February 7, 1948.

The meeting was opened with a technical session at 3:30 P.M. Saturday afternoon. The first speaker was Herbert Scull of the A. M. Tenney Associates, New York, N. Y., who spoke on "Current Dyeing Problems on Acetate-Viscose Blends and Suggestions on Meeting Them." The second speaker was Herman J. Jordan, Jr. of the Wiscassett Mills, Albemarle, N. C., who spoke on "Package Dyeing of Yarns."

A banquet was held at 7 P.M. at which time T. E. Christenberry, Clerk of the Court of Common Pleas and General Sessions for Greenville County, S. C., spoke. Mr. Christenberry's address was of humorous nature filled with homespun wit, which was thoroughly enjoyed by everyone.

Approximately 200 attended the meeting.

Respectfully submitted,
R. H. Smith, *Secretary.*

—♦ ♦—

Meeting, PTI Student Chapter

THE regular monthly meeting of the Philadelphia Textile Institute Student Chapter was called to order by the chairman on February 5th.

H. R. Tisdale of the American Dyewood Company spoke on the application of logwood to wool, nylon, and silk. Mr. Smith from the same company performed some experiments with chrome and natural dyes.

Respectfully submitted,
Doris Mae McAllister, *Secretary.*

—♦ ♦—

April Meeting of South Central Section

A MEETING of the South Central Section will be held at 5:00 P.M. at the Patten Hotel, Chattanooga, Tenn., on April 10th. Speakers are: Norman F. Barnes: "ABC of Color and Spectrophotometry"; Prof. Stuart Purser: "The Artist's Viewpoint of Color and Design in Textiles". Dinner will be served at 7:30 P.M.

152nd and 153rd Meetings of the Research Committee

THE 152nd meeting of the Research Committee, on Friday evening, October 24, 1947, was open to all attending the convention at the Congress Hotel n Chicago; and was devoted to a review of the accomplishments and plans of the Committee, as reported in the AMERICAN DYESTUFF REPORTER of December 29, 1947.

The 153rd meeting followed the Council meeting in New York on Friday, January 9, 1948, with Chairman J. Robert Bonnar presiding. Present were W. D. Appel, P. J. Ariente, E. C. Atwell, G. L. Baxter, W. von Bergen, W. H. Cady, W. W. Chase, M. A. Dahlen, J. N. Dalton, C. W. Dorn, C. Z. Draves, A. W. Etchells, E. Freedman, M. H. Gurley, Jr., H. E. Hager, W. A. Holst, R. W. Jacoby, N. A. Johnson, D. P. Knowland, C. W. Lever, G. O. Linberg, L. S. Little, J. E. Lynn, A. R. Macormac, O. F. Marks, J. E. Meili, W. R. Moorhouse, A. D. Nute, J. R. Redmond, F. J. Rizzo, G. L. Royer, C. H. A. Schmitt, H. A. Scruton, H. G. Scull, C. A. Seibert, R. B. Seymour, J. H. Skinkle, R. H. Souther, J. A. Stevenson, H. W. Stiegler, H. H. Taylor, P. Theel, F. Tripp, F. R. Tripp, J. F. Warner, H. E. Wilde, P. J. Wood, and H. C. Chapin, Secretary.

For the Executive Committee on Research, Mr. Bonnar reported new committees on Snag Resistance, headed by Dr. J. E. Smith, and on Chlorine Retention, headed by A. W. Etchells. The Committee on Detergency had been split into three committees, on Wool, Cotton, and Standard Soil Cloth. The chairmen of the research committees on various subjects had been organized into a committee for coordination of future work; and the Sectional Research Committee Chairmen into a committee to give first consideration to problems suggested by replies to the recent questionnaire. Chairmen of committees were instructed not to assume the prerogatives of the general Chairman of Research or Council, in contracting for manufacture or selling prices of supplies developed by their committees.

Dr. Stiegler reported completion of work on two projects in Lowell; development for the Quartermaster Corps of an O.D. number 7 shade on cotton, of maximum fastness to destructive agencies, on which a rough draft of the report was ready for the advisory committee; and a comparison of the various methods of evaluating water resistance of fabrics, on which a report was being submitted to the committee on this subject before publication. The Dimensional Restorability machine was being tested, for reproducibility of results, on full lengths of 20 to 40 yard cuts of rayon cloth. The drying mechanism requires redesigning, and a smaller instrument of different construction is under consideration. On the basis of experience gained with the first model of the Detergency Machine, a new model is being completely redesigned. On the International Salt Company project, involving comparison of sodium chloride with Glauber's salt in dyeing, theoretical studies at Lehigh University are now being coordinated with mill experiments through courtesy of our members in Lawrence. The Quonset hut had been equipped for storage, and was in use by departments of Research and Secretary. The capacity of the constant temperature and humidity room had been doubled, and equipment augmented, by combination with facilities of the Lowell Textile Institute. Test methods offered to the Research Committee would hereafter, so far as possible, be submitted to the Committee, and others interested, in writing, for consideration before meetings.

For the Committee on Analysis of Fi er Mixtures, Professor Skinkle presented a report in writing, with request that comments be sent that committee as soon as possible. The term, "Proposed Methods", was suggested by Mr. Appel, for methods discussed by the Research Committee, but not voted "Tentative" or "Standard".

For the Committee on Light Fastness, Mr. Holst reported that within three months the National Bureau of Standards hoped to have ready for distribution a supply of Fadeometer calibration papers adequate for at least two years, with instructions for use published in the 1948 Year Book. Mr. Appel believed that the papers, protected from light, would retain their characteristics indefinitely, but suggested renewal of laboratory supplies every six months.

For the Committee on Fastness of Dyed Materials to Perspiration, Mr. Dalton recommended test cloth of flat construction, without raised fibers or floats, and work on the plate method with measured pressures. The effect of salt and its concentration, and the test method of the Society of Dyers and Colourists, were under investigation. There were questions as to the pH of the fabric itself in a solution of known pH, and whether there should be different tests for apparel and utility fabrics. Mr. Knowland suggested that in all tests which might involve the Color Transfer Chart, samples be large enough to cover the holes in the chart.

For the Committee on Testing of Fire Resistant Textiles, Mr. Redmond reported work on a new type of test cabinet.

For the Committee on Flammability of Textiles Dr. Hager reported recommending reduction of the Flammability Test from status of a Standard to that of a Tentative Method; confirming action to that effect by the Council, and report thereof, by Dr. Hager, to the National Bureau of Standards. The Research Committee voted approval.

Regarding the new Analytical Methods, Professor Theel reported five sections, out of nine, nearly ready for printing.

For the new Committee on Small Color Differences, Mr. Knowland reported that color filters, which seemed satisfactory for the viewing device developed by his committee, had at last been secured, and were to be sent to the members of the committee for trial. This committee, Mr. Scull stated, would handle remaining problems of his Committee on Atmospheric Fading of Dyed Acetate Rayons, which hereafter would be a reference committee.

For the Committee on Fastness to Washing, Mr. Seibert reported continuation of work on modification of the number 3 test, to duplicate the average damage to color observed in the number of washings a fabric normally receives. Though considering other equipment, the committee hoped to fit the new test to the Launderometer, because of over 900 of these machines now in use. Whether damage to color, or to the textile material, determines the useful life of a fabric, and how much of either, are questions yet to be settled, in consultation with Committee

L-14 of the A.S.T.M.

For the Committee on Evaluation of Durable Finishes, Mr. Gurley reported that little could be done until other committees had established standard tests for the various factors involved.

For the Committee on Standard Methods of Determining Finishing Materials in Textiles, Dr. Lynn reported inability of his committee to get consistent results with methods of resin analysis available, or to develop methods without assistance of a full time chemist under direction of our Research Dept., which he asked for this project.

On the question of a Crockmeter to be made and sold abroad, W. C. Durfee was reported in correspondence with Mr. Fargher, of the British Society of Dyers & Colourists.

Test methods for publication in the Year Book had been revised in form by Dr. Draves, for consistent appearance and convenient use. Printer's proofs would be sent to committee chairmen for their approval.

New test fabrics were reported available from Werner Klaas of Testfabrics, 224 West 35th St., New York 1, N. Y. The first is similar to the old Multifiber fabrics, but of firmer construction, containing filling stripes of Wool, Viscose, Spun Silk, Bleached Cotton, Acetate, and Nylon, assembled in 2 in. strips, with a waste stripe between repeats, in fabric 38 inches wide, at present price of $4.00 per yard. The second contains Acetate, Wool and Bleached Cotton, so woven as to show on its surface one inch squares of acetate and wool, and two inch squares of cotton. This is 54 inches wide, and is for the present priced at $3.50 per running yard.

Respectfully submitted,
H. C. Chapin, *Secretary.*

—♦ ♦—

Membership Applications

STUDENT

Zuheir A. Kotob—North Carolina State College. Sponsor: A. H. Grimshaw.

Sien-Wang Loh—North Carolina State College. Sponsor: A. H. Grimshaw.

Harold B. Peterson—North Carolina State College. Sponsor: A. H. Grimshaw.

Harold Rogers—New Bedford Textile School. Sponsor: F. Tripp.

Fred M. Sizemore, Jr.—North Carolina State College. Sponsor: A. H. Grimshaw.

Charles P. Wolhar—North Carolina State College. Sponsor: A. H. Grimshaw.

Vincent B. Wright, Jr.—North Carolina State College. Sponsor: A. H. Grimshaw.

NEW TEST FABRICS

New test fabrics are available from Werner Klaas of Testfabrics, 224 West 35th Street, New York 1, N. Y.

Of the two sponsored by the Association, one is similar to the old Multifiber Fabric, but of firmer construction, containing filling stripes of Wool, Viscose, Spun Silk, Bleached Cotton, Celanese Acetate, and Nylon, assembled in 2 inch strips, with a waste stripe between repeats, in fabric 38 inches wide, at present price of $4.00 per yard.

The second contains Acetate, Wool, and Bleached Cotton, so woven as to show on its surface one inch squares of Acetate and Wool and two inch squares of Cotton. This is 54 inches wide, and is for the present priced at $3.50 per yard.

Correction

"Some Aspects of the Ageing of Coated Fabrics" by E. V. Painter, Appearing in the December 29, 1947 issue.

DUE to an error in the original copy, Figure 4 was incorrect as published. The WARP load elongation diagram for the *Coated Fabric*, 800 hours oven aged, should extend in a straight line from the end point as shown to the point at 58.0 pounds load and 7.5 per cent elongation where rupture occurred. The tensile energy as reported for this curve as 189.9 per cent of original in Table IV is correct.

The correct Figure 4 appears herewith.

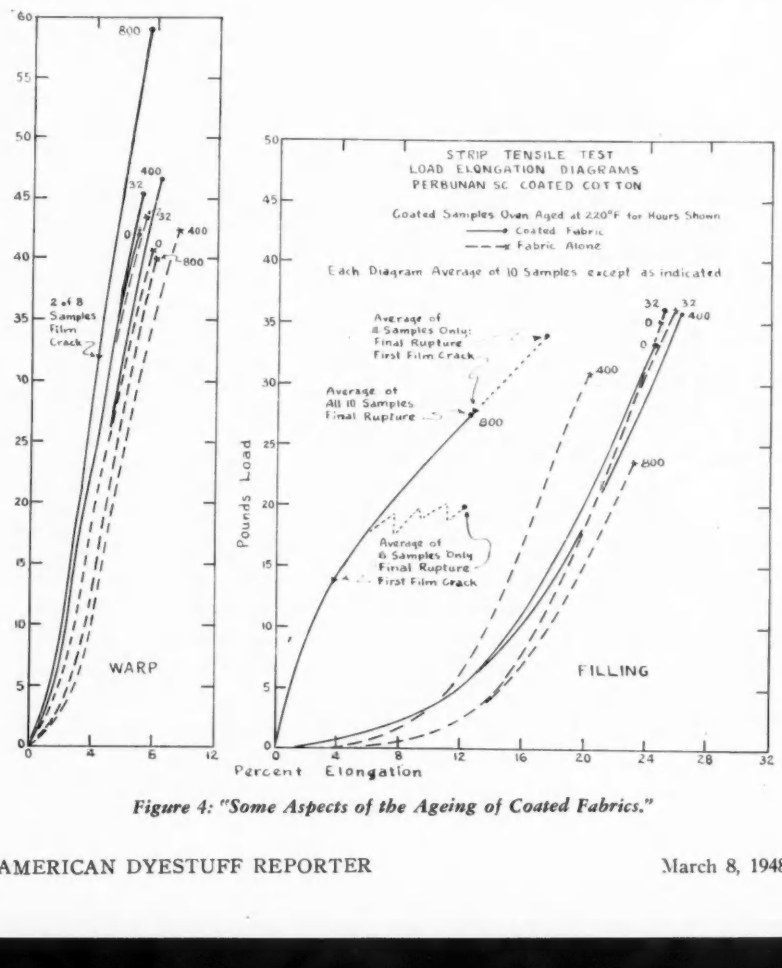

STRIP TENSILE TEST
LOAD ELONGATION DIAGRAMS
PERBUNAN SC COATED COTTON
Coated Samples Oven Aged at 220°F for Hours Shown
Coated Fabric
Fabric Alone
Each Diagram Average of 10 Samples except as indicated
Average of 8 Samples Only: Final Rupture First Film Crack
Average of All 10 Samples Final Rupture
Average of 6 Samples Only Final Rupture First Film Crack
2 of 8 Samples Film Crack
WARP
FILLING
Pounds Load
Percent Elongation

Figure 4: "Some Aspects of the Ageing of Coated Fabrics."

Intersectional Contest ☆Second Prize Winner☆

The Application of Chemical Controls to Acid Dyeing*

Presented by
PHILADELPHIA SECTION

COMMITTEE

Richard B. Stehle, *Chairman and Speaker*
Curt R. Baeringer
Elmer C. Bertolet
Felice J. De Maria
Harold L. De Turck
Dr. Edwin C. Dreby
Wm. Ebersold
Arthur W. Etchells
Walter F. Fancourt, III
Joseph E. Goodavage
Edwin J. Grajeck
Dr. O. B. Hager
Herbert C. Haller
M. H. Klein
Constantin J. Monego
Harry L. Morgan
Thomas J. Scanlon
Dr. Robert J. Thomas
Dr. Harold H. Tucker
Jackson A. Woodruff

MANY investigations[1,2,3] have been carried on with the purpose of providing means of controlling dyeing operations. The principal means have been thermometric and chemical. Thermometric controls have been quite generally applied and studies in this field, particularly by Goodall[4], show the advantages of commencing the dyeing operation at temperatures above 180° F. Temperature as a variable factor will therefore not be considered in this work. The chemical methods of control are generally dependent upon the control of the pH of the dyebath. However, pH is not the only factor in dye absorption as demonstrated by Briggs and Bull[5].

Practically all previous work has been done from an equilibrium standpoint. Little or no work has been done, however, on studying control of the speed of dyeing continuously from the start to the end of the operation. What is happening during the dyeing operation is more important fundamentally than the exhaustion of the bath at the end. The use of chemical controls to regulate the rate of dyeing becomes very significant and is the ultimate purpose of our investigation.

Procedure

Two hundred pounds of wool, 2/20-50's grade, were scoured in a four bowl Sargent scouring train using a sodium alkylaryl sulfonate, soda ash and sodium metasilicate. After passing through the scouring train, the lot was washed three additional times in water for 15 minutes at 110° F. A fourth bath was made up and a temperature of 120° F. was maintained. Enough acetic acid was added to neutralize practically all excess alkalinity. The wool was dried and pH determinations made according to the ASTM procedure. The aqueous solution in contact with the wool had a pH of 8.0.

Standard weight skeins were prepared after conditioning at 70° F. and 65% relative humidity for 24 hours.

Dyeings were made in baths containing distilled water in a liquor ratio of 30 to 1. Except in the rate of dyeing studies, the baths were open, the yarn turned regularly and the temperature kept at the boil. The volume was kept approximately constant and brought back to the original volume at the end of the experiment.

In the experiments involving rates of dyeing, the procedure was as follows: A closed dyebath was connected by top and bottom arms to a small centrifugal pump which maintained a circulation rate of 2.5 cycles per minute. By means of a stop cock a small portion of liquor could be drawn off at desired intervals, tested and returned to the bath. A reflux condenser was attached to maintain constant volume. The bath was heated by an electrically wired jacket and kept at a temperature of 205° F. within 1° F. by means of a thermostat and relay.

Chemicals used were of C.P. quality unless otherwise designated. Dyes were commercial grade.

The pH measurements were made using a glass electrode and dye bath concentrations were measured spectrophotometrically.

Approximately constant pH was obtained in the rate of dyeing experiments (1) by means of buffer solutions and (2) by adjusting the pH before adding dyestuff and then adding minute quantities of acid or alkali to correct the pH as the dyeing progressed. The second method was found capable of giving very close control. It also approached more nearly practical dyeing conditions and was therefore used.

The buffer solutions were 0.2 molar as to the salt, and consisted of the following combinations:

Buffers	*pH*
Borax—boric acid	8.6
Borax—monopotassium phosphate	7.6
Borax—monopotassium phosphate	6.6
Trisodium citrate—citric acid	5.6
Sodium acetate—acetic acid	4.6
Sodium formate—formic acid	3.6
Trisodium citrate—citric acid	2.6

Effect of Dye Concentration on the Dyeing Curves

In making comparative studies of the properties of dyestuffs, comparisons are sometimes made on the basis of molecular weights and other times on the basis of equivalent weights of the dyestuffs. Either method involves a lengthy process of purification.

In Fig. 1 are shown the dyeing curves which result from concentrations varying from 0.05% to 4% with Azo Rhodine 6B (Sandoz) (Amido Naphthol Red 6B C.I. 57) at pH 3.6.

The closeness of the curves indicates that the effect of varying concentration is minor.

Similar dyeing curves were obtained

* Presented at Intersectional Contest, National Convention, Chicago, October 25, 1947.

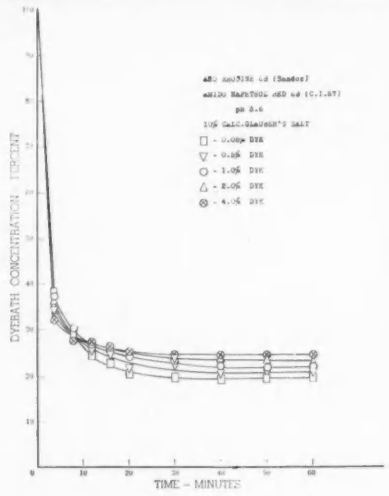


Figure 1

with varying concentrations of the following:

Alizarine Blue Black B (duPont)—(Alizarin Blue Black C.I. 1085).

Polar Green CG (Geigy)—(Alizarin Cyanine Green C.I. 1078).

Calcocid Alizarine Blue SE (Calco)—(Alizarin Saphirol SE C.I. 1053).

The use of commercial dyes of anknown pure dye content is therefore valid, within practical limits, for this purpose.

Dyestuff Absorption Curves

Five one per cent dyeings were made simultaneously, using 10% calcined Glauber's salt with varying quantities of phosphoric acid to yield a final pH of approximately 7,6,5,4 and 3 respectively, after boiling for one hour. At the end of one hour, spectrophotometric and pH determinations were made. The results are shown in Figs. (2) to (41).

That these curves are generally true is shown by Fig. (42) where two different dyes, Amido Naphthol Red 6B (C.I. 57) and Polar Red RL (C.I. 430), are applied on three distinct grades of wool. This figure shows that with increasing fineness of fiber the curves are displaced toward the pH axis. The acid milling dye is displaced much less than the acid equalizing dye but the characteristic trend is the same.

These curves offer a means of comparison of dyestuffs both generally and at specific pH values.

The nearer the points on the curve lie to the pH axis the more completely the color exhausts. Dyes whose curves lie at the same distance from the pH axis exhaust similarly, for example Amido Naphthol Red G. (C.I. 31) and Alizarin Saphirol SE (C.I. 1053) Figs. (4) and (32).

An approximate rating can be given each dye by finding the area under the curve to the pH axis and between the limits of ordinates erected at pH 6.5 and pH 3. This area can be obtained with a planimeter and expressed as a percentage of the total area between the two ordinates.

For example, Sorbine Red (C.I. 54) Fig. (7), an equalizing acid dye, would have a rating of 45 percent and Eriochrome Black T (C.I. 204) Fig. (15), an acid milling dye, would have a rating of 1 percent.

With such a set of percentages, it is possible to classify dyes in the order of their exhaustion, thereby giving the dyer a rapid method of selecting dyes to use in the same formulation. When shade corrections are necessary it is well to use a dye with a higher percentage rating to insure level results. Ratings are given in Table I.

TABLE I

Fig.	C.I. Name	C.I. No.	Rating
2	Crocein Orange G	(C.I. 26)	16
3	Orange G	(C.I. 27)	39
4	Amido Naphthol Red G	(C.I. 31)	38
5	Alizarin Yellow 2G	(C.I. 36)	27
6	Alizarin Yellow R	(C.I. 40)	18
7	Sorbine Red	(C.I. 54)	46
8	Chromotrop 6B	(C.I. 56)	34
9	Ponceau R	(C.I. 79)	16
10	Palatine Chrome Brown 2G	(C.I. 98)	16
11	Orange II	(C.I. 151)	24
12	Orange R	(C.I. 161)	12
13	Eriochrome Blue Black B	(C.I. 201)	3
14	Eriochrome Blue Black R	(C.I. 202)	6
15	Eriochrome Black A	(C.I. 204)	1
16	Eriochrome Flavine A	(C.I. 219)	25
17	Naphthol Blue Black	(C.I. 246)	12
18	Milling Orange	(C.I. 274)	10
19	Cloth Scarlet G	(C.I. 275)	7
20	Sulphon Cyanine 5R Ex.	(C.I. 289)	4
21	Anthracene Yellow C	(C.I. 343)	2
22	Polar Red	(C.I. 430)	2
23	Xylene Light Yellow	(C.I. 639)	35
24	Tartrazine	(C.I. 640)	30
25	Eriochrome Red B	(C.I. 652)	5
26	Guinea Green B	(C.I. 666)	7
27	Formyl Violet S 4B	(C.I. 698)	3
28	Patent Blue V	(C.I. 712)	49
29	Eriochrome Azurole B	(C.I. 720)	15
30	Eriochrome Cyanine R	(C.I. 722)	11
31	Wool Fast Blue	(C.I. 833)	7
32	Alizarin Saphirol SE	(C.I. 1053)	37
33	Alizarin Saphirol B	(C.I. 1054)	26
34	Alizarin Cyanine Green	(C.I. 1078)	7
35	Alizarin Blue Black B	(C.I. 1085)	11
36	Acid Chrome Blue 2R	(Pr. 7)	10
37	Anthracene Chromate Brown EB	(Pr. 14)	7
38	Guinea Carmine B	(Pr. 100)	25
39	Milling Yellow H5G	(Pr. 138)	2
40	Polar Orange R	(Pr. 152)	3
41	Sulphon Yellow R	(Pr. 187)	2

Care must be taken to use colors which are suitable at the pH at which the dyeing is conducted. An interesting case is shown in Fig. (43), where the curves of both Tartrazine and Fast Light Yellow are shown. At pH values higher than 5.6 Fast Light Yellow exhausts more completely and below this pH value Tartrazine exhausts more completely.

Another interesting example is shown in Fig. (44). The three curves of dyes listed under Xylene Light Yellow (C.I. 639) show how the properties of some dyes listed under the same color index number may vary. Very few examples of this were found however.

Acid Transfer Rate

Many studies have been made of the action of acids on wool in a dyebath. The classic example is the study of Elod[6]. All studies conducted thus far have been concerned with the total acid absorption at equilibrium. In this work the study of acid distribution was attempted, in order to find an answer to the following questions.

1. How soon after an acid is added to the dyebath is this acid evenly distributed throughout the dyelot?
2. Why does a dyer frequently use acetic acid to exhaust some neutral dyeing acid colors? Why not use sulfuric acid in small percentages for the same job?
3. How does Glauber's salt influence the rate of acid distribution?

It is fully realized that the wool dyer has arrived at the answer to the above questions in an empirical manner, that is, by establishing a dyeing procedure which yielded level dyeings.

Thoroughly wet out skeins of wool were boiled with 4 percent sulfuric acid with and without Glauber's salt for 1, 5, 10 and 20 minutes. The acid absorbed by the skeins was determined by extracting with pyridine as outlined by Barritt[7].

The acid remaining in the bath was titrated as a crosscheck. The acid absorption curve thus obtained is shown in Fig. (45). Fig. (46) shows a similar experiment run with acetic acid for 10 minutes. It can be clearly seen that practically all the acid absorption takes place during the first 5 minutes.

On the basis of these experiments the acid transfer tests were made by placing a well wet out skein in the acid bath and boiling for 5 minutes. A second skein was added and the boiling continued for 1 additional minute. The skeins were withdrawn together and the acid content of each was determined. Four additional tests were then conducted, again immersing the first skein for 5 minutes boiling time, then adding a second skein for an additional boiling time of 5, 10, 20 and 30 minutes respectively. ¼, ½, 1, 2 and 4 percent of sulfuric acid based on the sum of the weights of the two skeins were tried with and without Glauber's salt, as shown in Figs. (47) to (56). Two percentages of acetic acid, ¼ and ½ were tried with and without Glauber's salt as shown in Figs. (57) to (60). The transfer was so rapid that further testing was deemed unnecessary. Boiling with acetic acid was carried out under reflux condensers.

The preceding graphs Figs. (47) to (56) show that 4% sulfuric acid transfers rapidly in less than 5 minutes, while with ¼% sulfuric acid the transfer of acid from one skein to the other is not com-

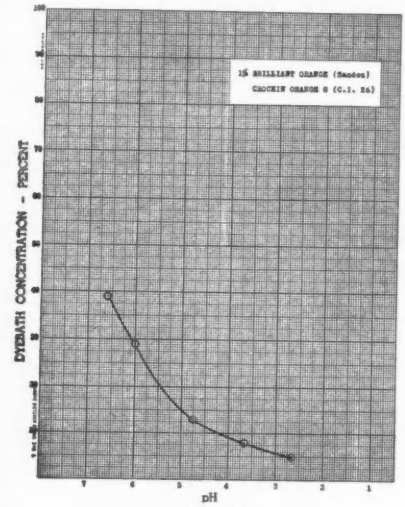


Figure 2

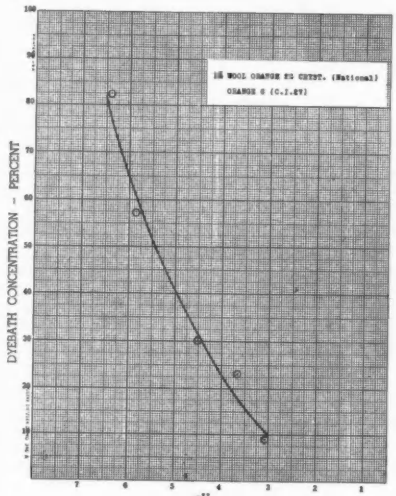


Figure 3

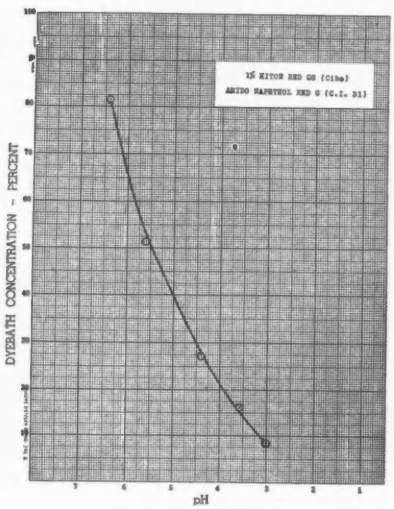


Figure 4

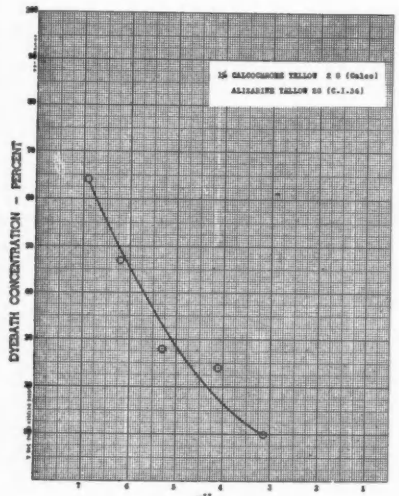


Figure 5

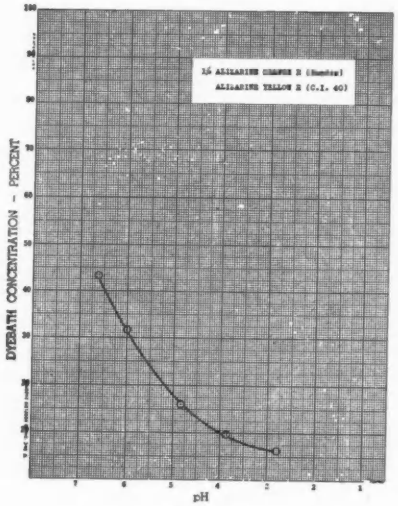


Figure 6

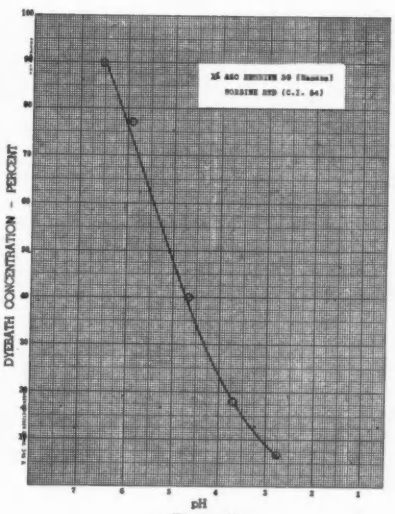


Figure 7

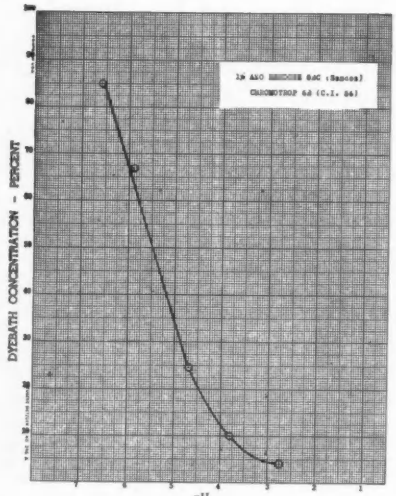


Figure 8

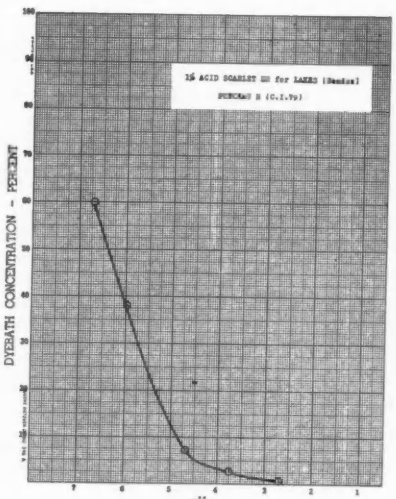


Figure 9

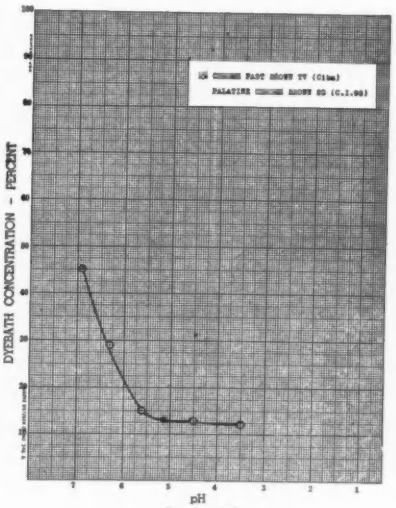


Figure 10

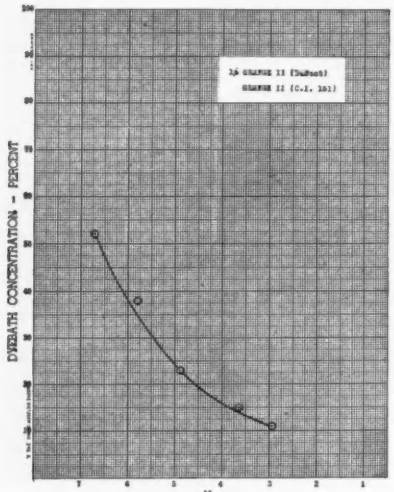


Figure 11

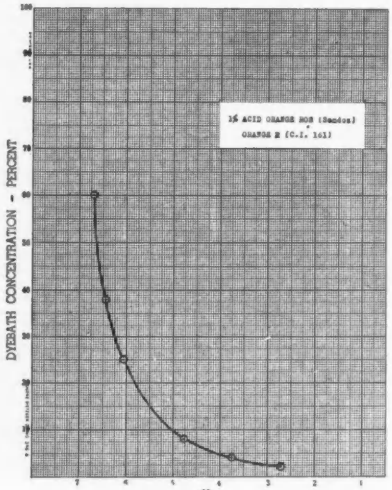


Figure 12

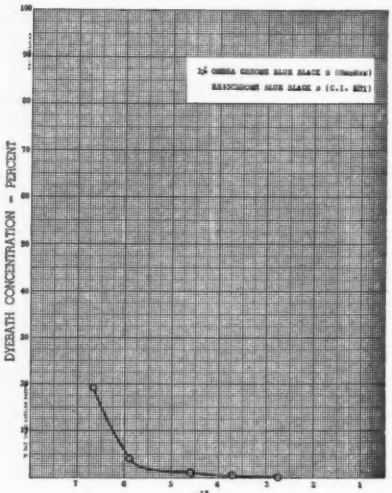


Figure 13

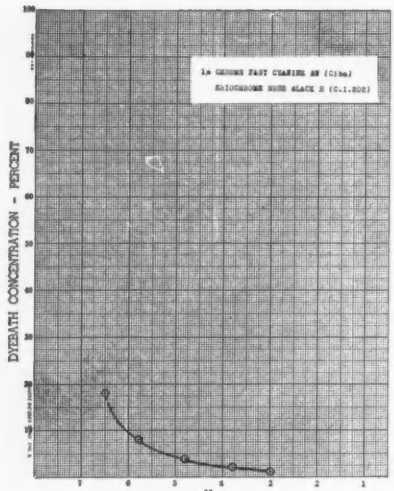


Figure 14

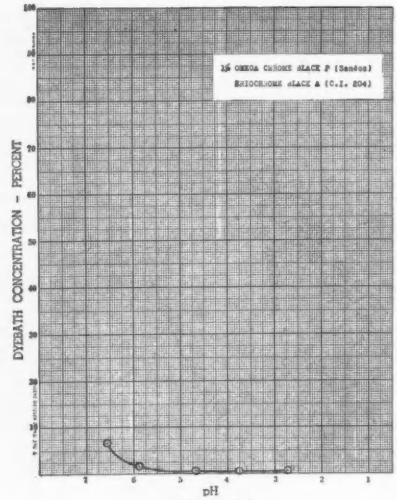


Figure 15

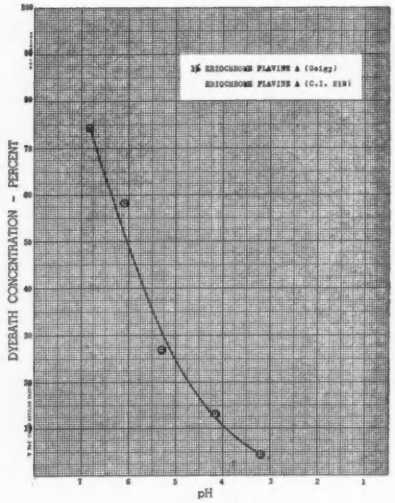


Figure 16

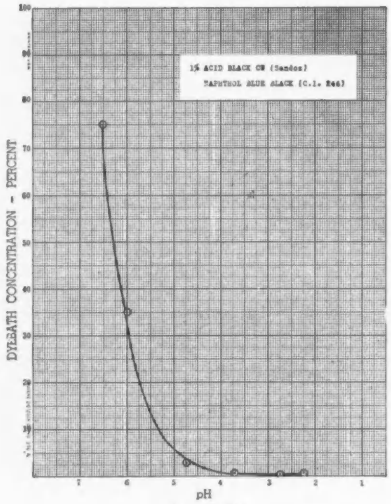


Figure 17

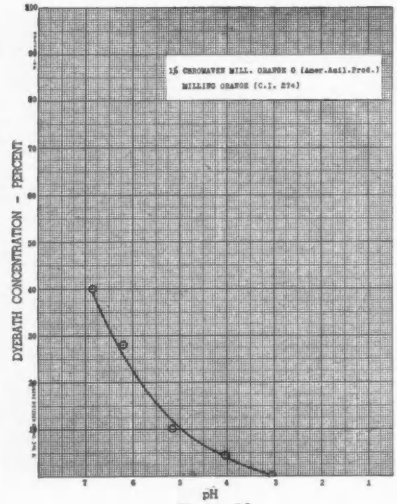


Figure 18

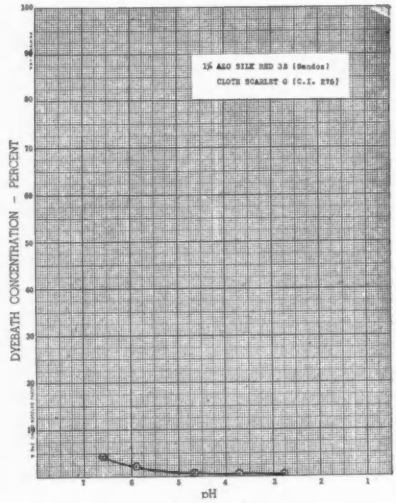


Figure 19

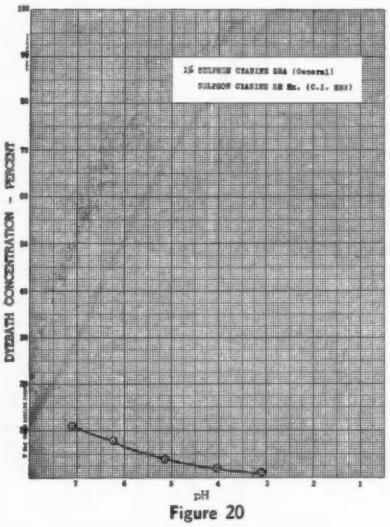


Figure 20

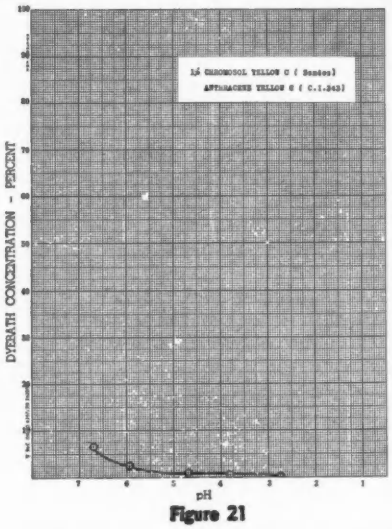


Figure 21

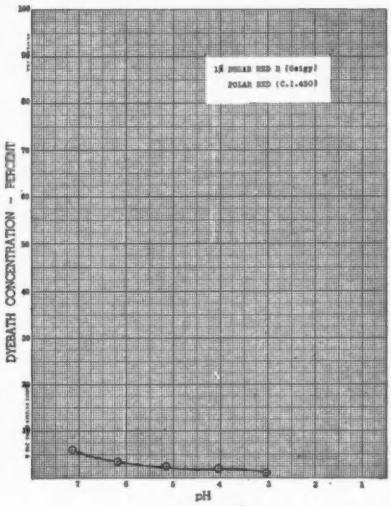


Figure 22

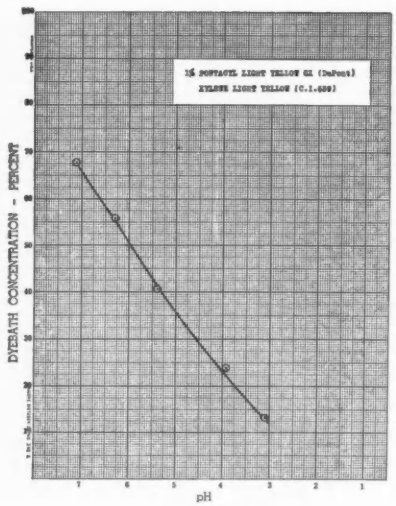


Figure 23

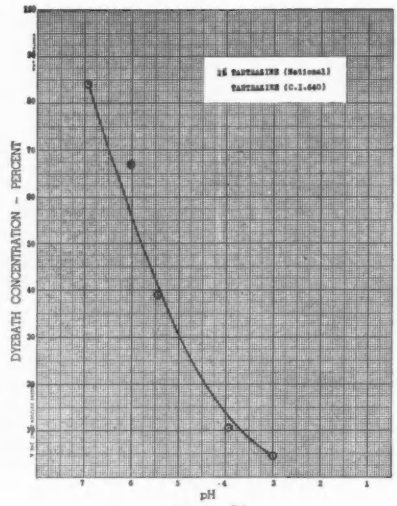


Figure 24

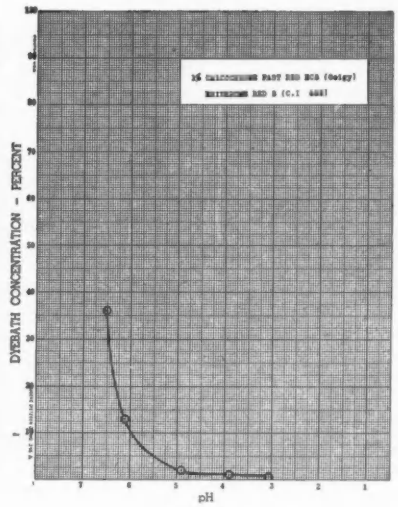


Figure 25

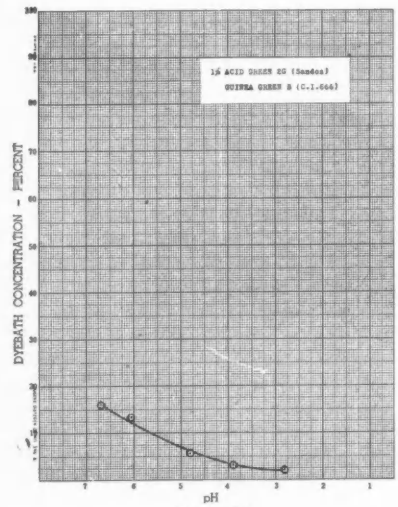


Figure 26

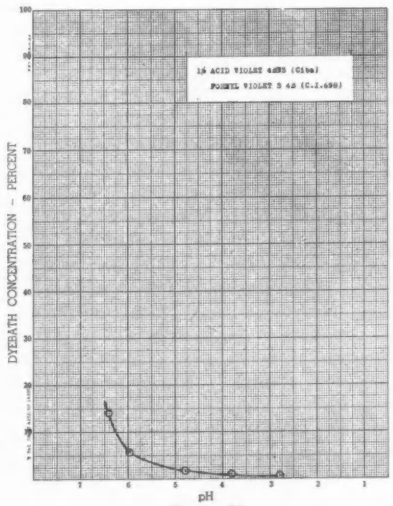


Figure 27

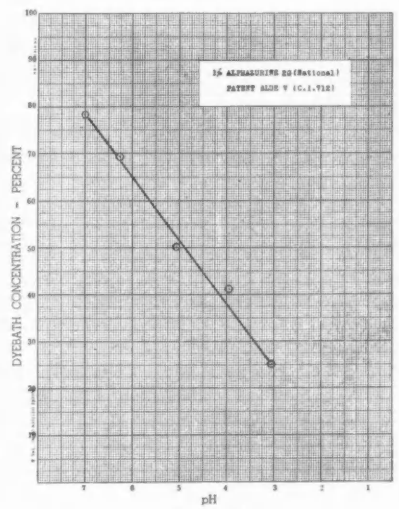


Figure 28

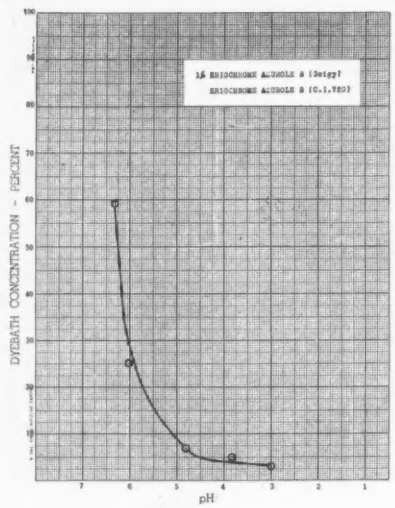


Figure 29

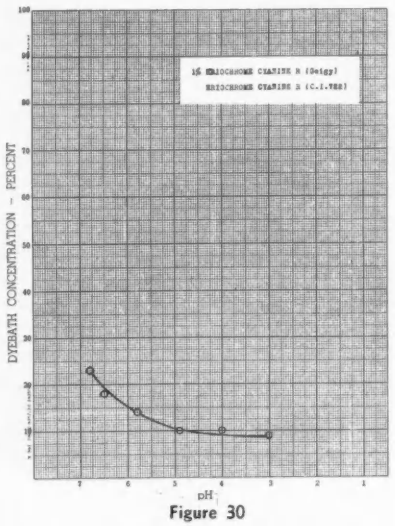


Figure 30

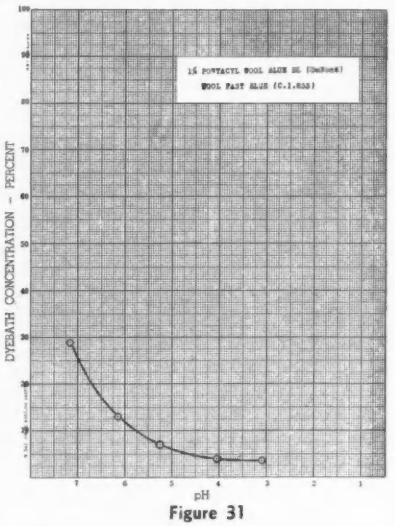


Figure 31

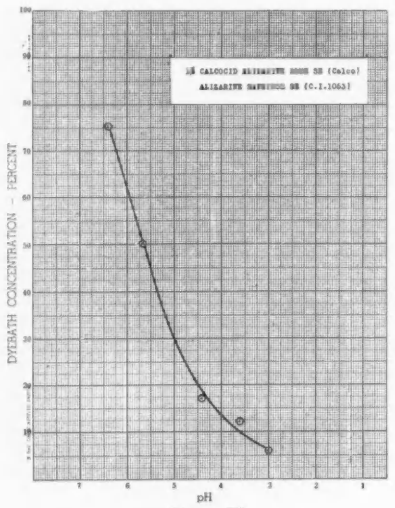


Figure 32

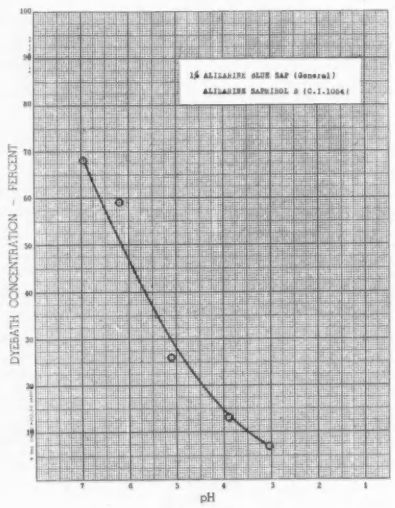


Figure 33

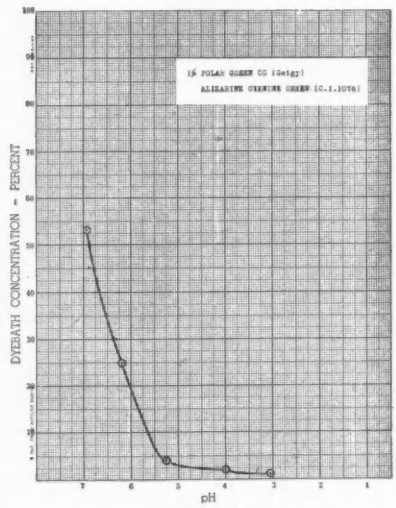


Figure 34

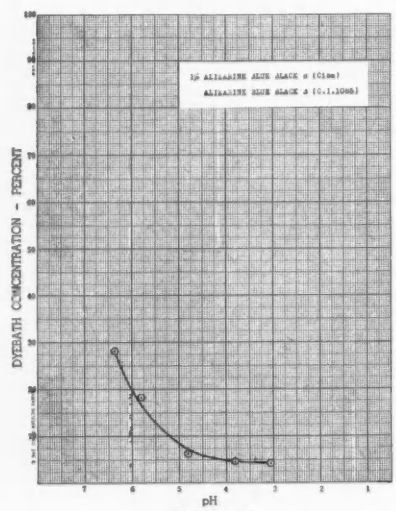


Figure 35

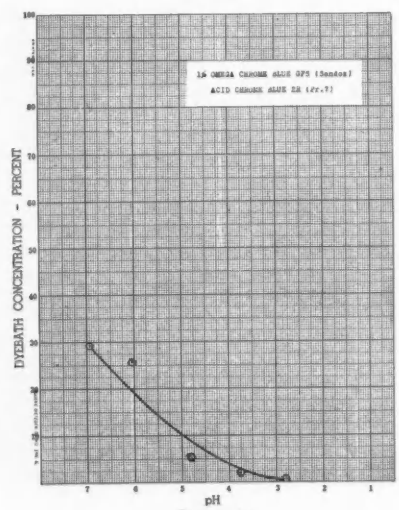


Figure 36

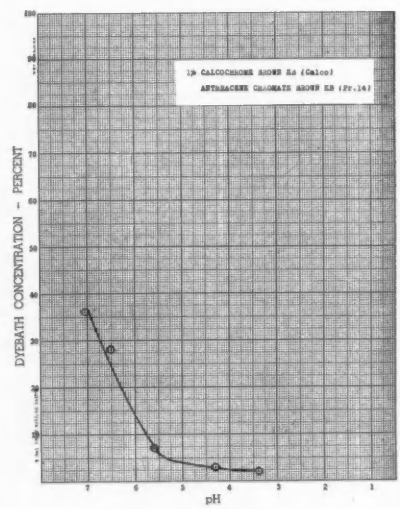


Figure 37

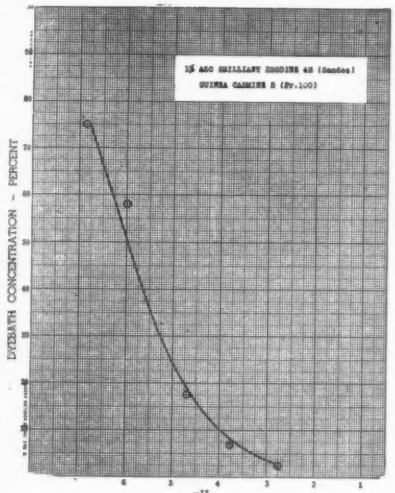


Figure 38

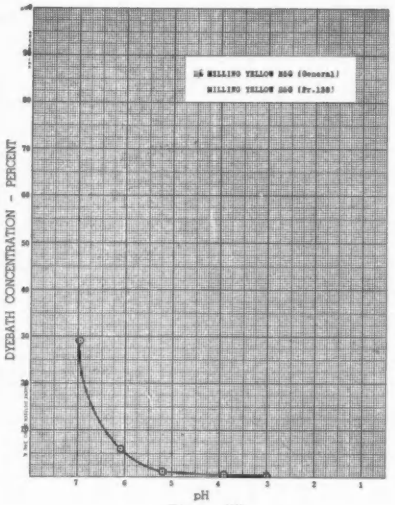


Figure 39

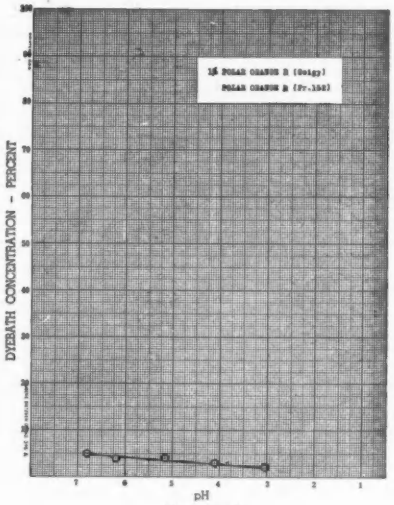


Figure 40

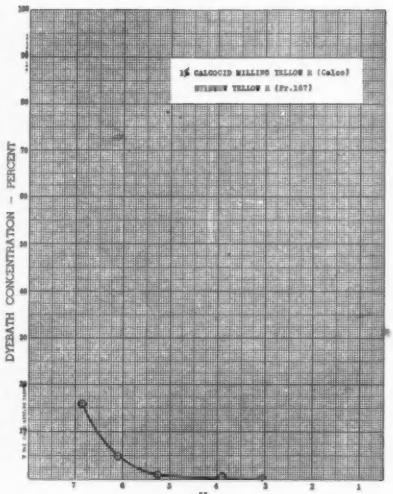


Figure 41

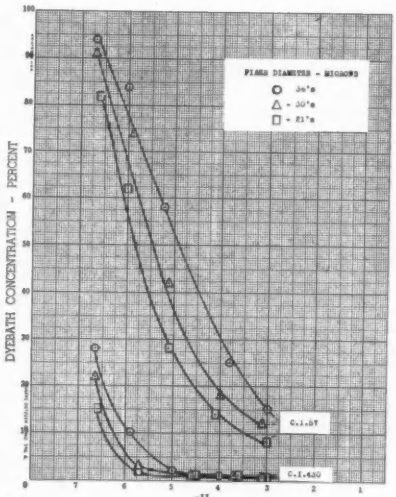


Figure 42

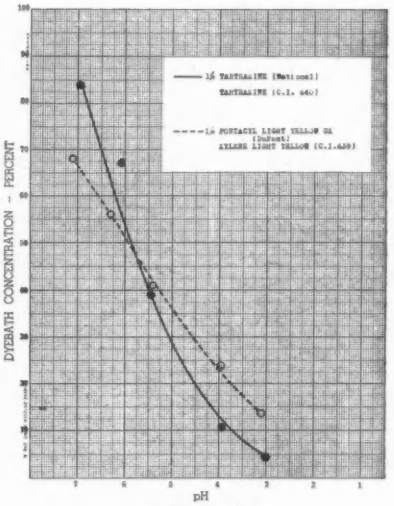


Figure 43

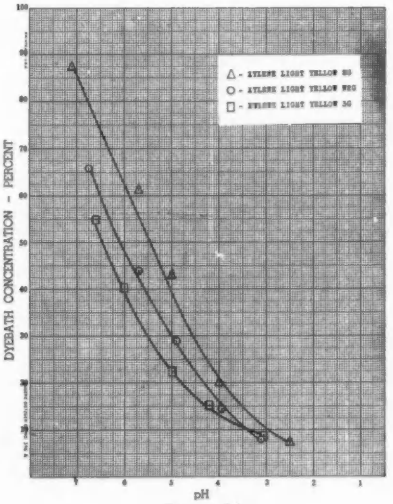


Figure 44

plete after ½ hour. The concentration of acid must be 2% or more to transfer in 10 minutes. Glauber's salt in a sulfuric acid bath tends to slow the rate of acid absorption and accelerates acid transfer so that the two skeins reach equilibrium more rapidly.

Figs. (57) to (60) show that the acid transfer for ¼% acetic is complete in 10 minutes and for ½% acetic acid is complete in 5 minutes. The addition of Glauber's salt increases acetic acid absorption by the wool as shown by Fig. (46).

When low percentages of acid are used, the slow transfer of sulfuric acid makes it unsuitable. Slow acid transfer leads to unequal dye distribution and uneven dyeing. An acid, like acetic, with excellent transference, is required.

A Practical Method of Obtaining pH of Dye Bath

The attainment of definite pH values becomes a matter of practical importance.

Since wool is slow to reach equilibrium with acid at low temperatures, raise to the dyeing temperature, take the pH of the bath, and add a quantity of acid based on Figs. (61) to (66). In any specific case, it is well to make a first addition of acid based on previous experience.

The amount of acid necessary in any case will vary depending on the amount of alkali or acid carried over from previous treatments. This method is in practical use and working successfully.

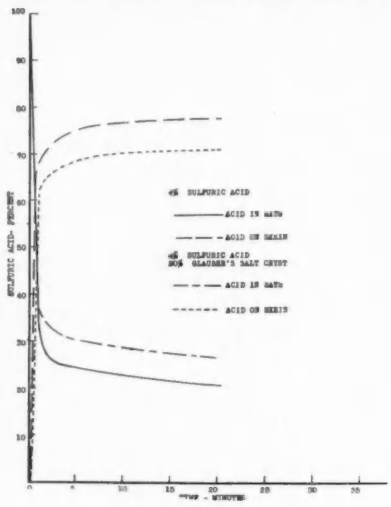


Figure 45

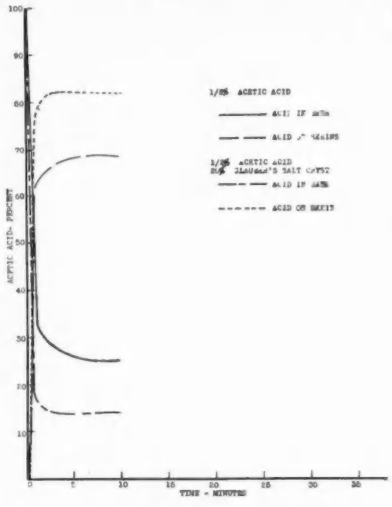


Figure 46

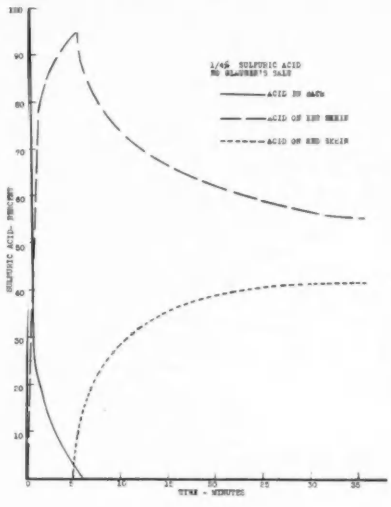


Figure 47

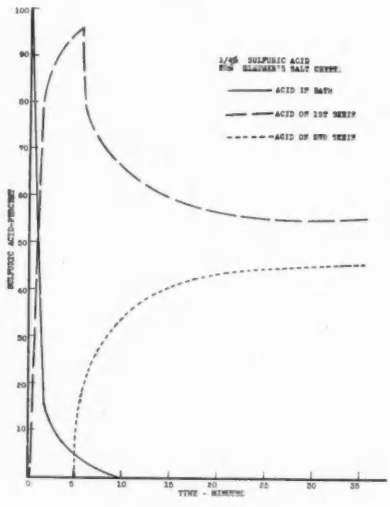


Figure 48

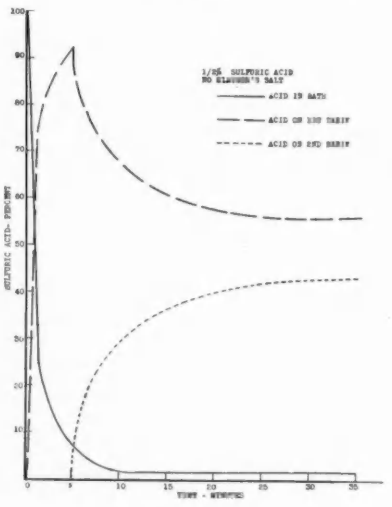


Figure 49

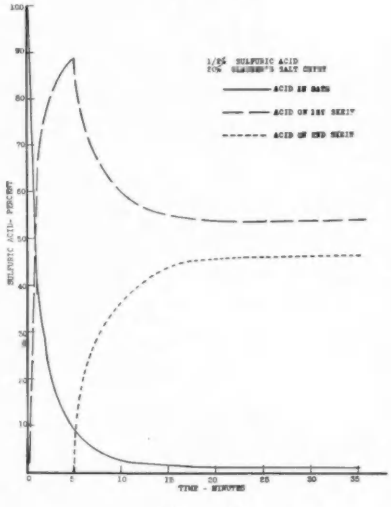


Figure 50

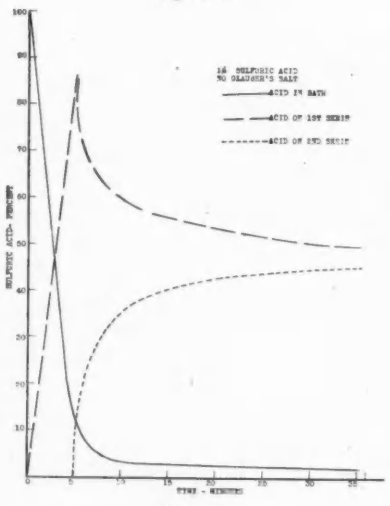


Figure 51

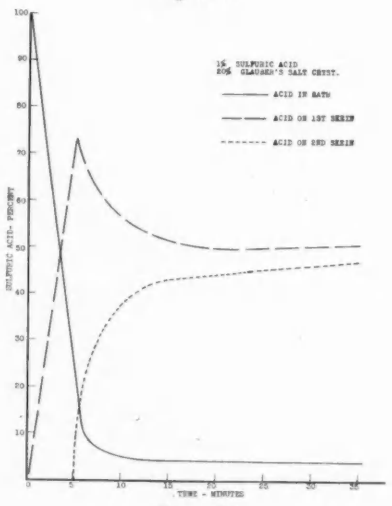


Figure 52

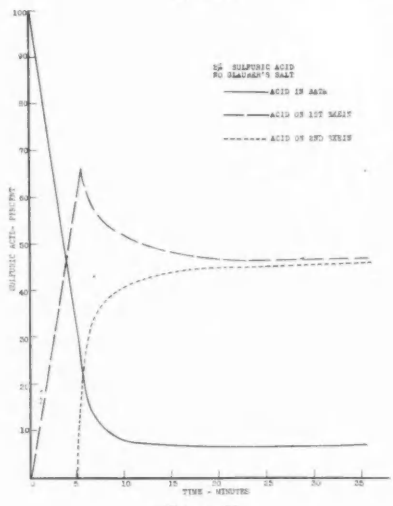


Figure 53

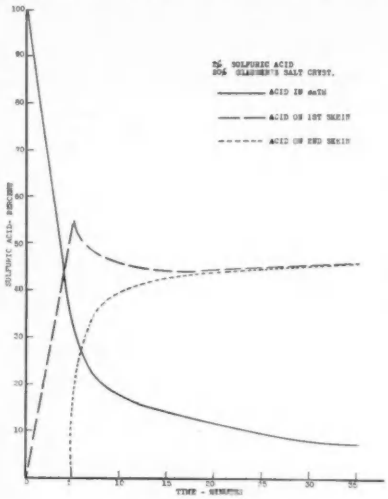


Figure 54

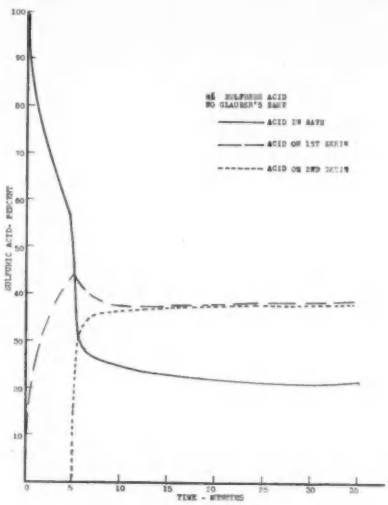


Figure 55

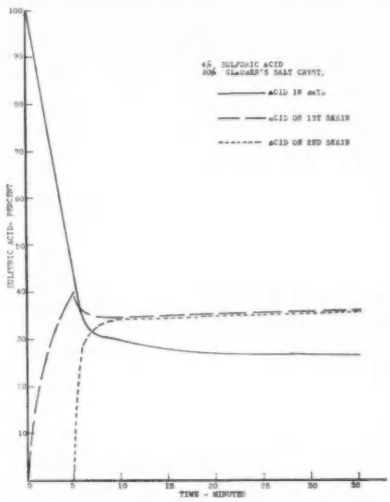


Figure 56

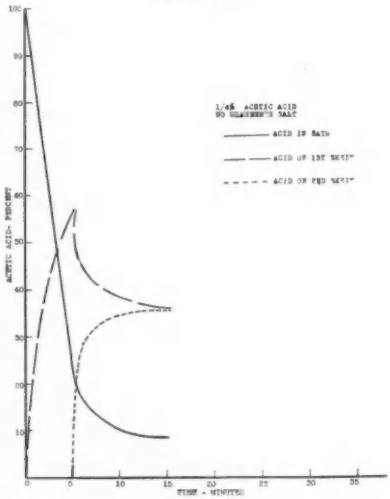


Figure 57

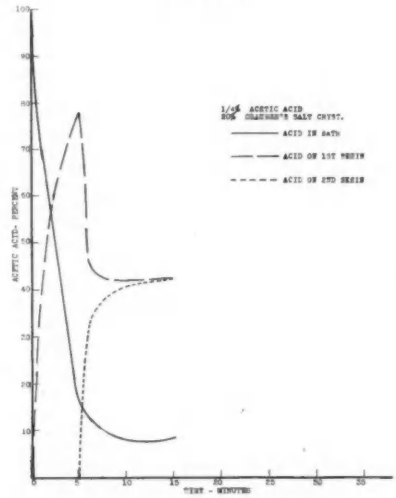


Figure 58

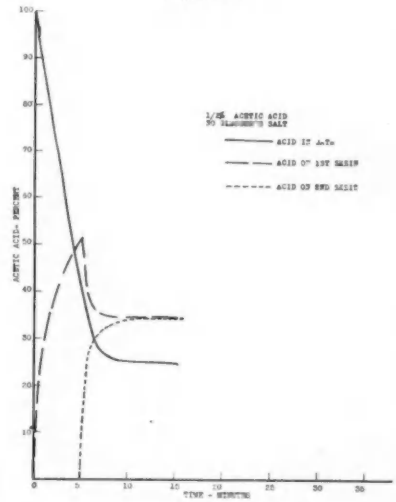


Figure 59

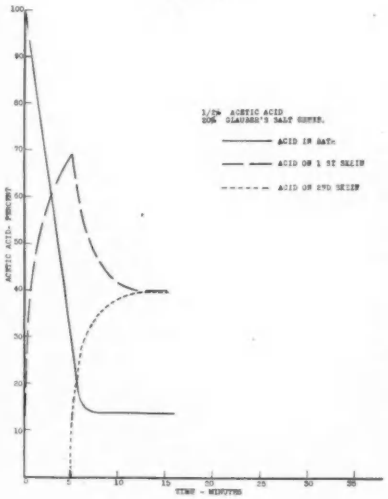


Figure 60

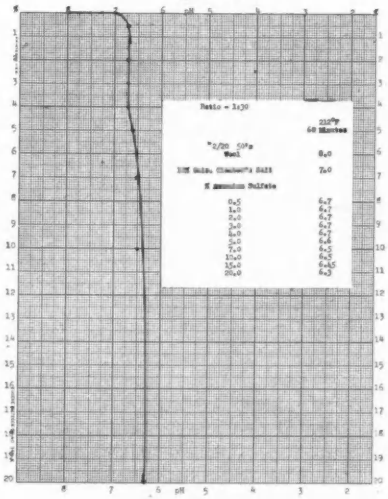


Figure 61
Ammonium Sulfate

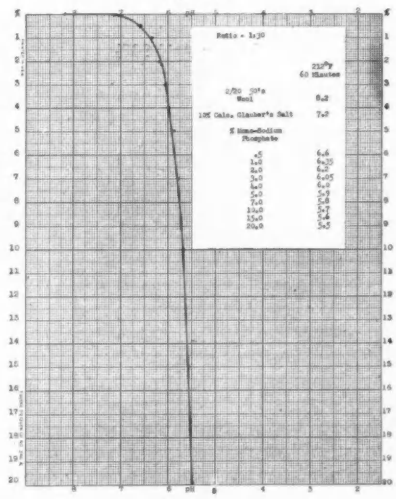


Figure 62
Mono-Sodium Phosphate

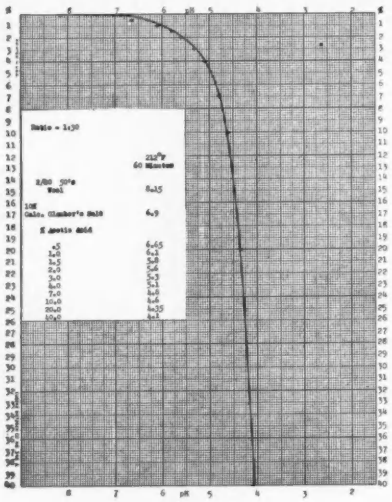


Figure 63
Acetic Acid 28%

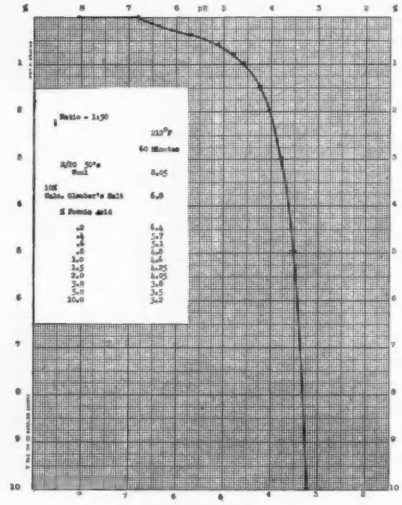


Figure 64
Formic Acid 90%

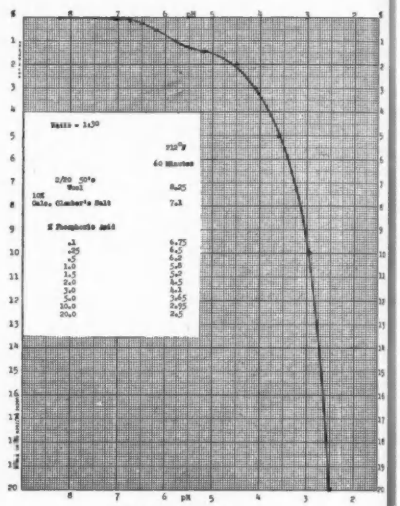


Figure 65
Phosphoric Acid 75%

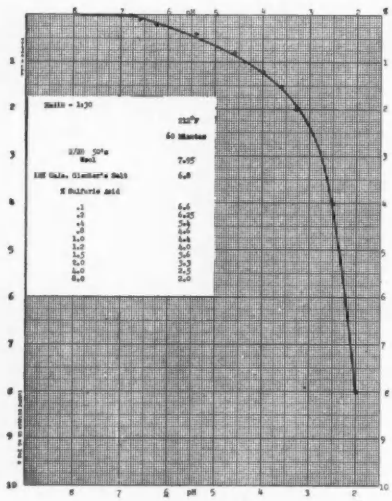


Figure 66
Sulfuric Acid 98%

Buffer Action

One of the problems in chemical control is the attainment of a desired pH within narrow limits.

The use of buffer salts in dye baths has occasionally been mentioned[8] but not investigated.

Van Slyke[9] defined buffer capacity as the differential ratio dB/d(pH), expressing the relationship between the increment (in gram equivalents per liter) of strong base or strong acid added to a buffer solution and the resultant increment or decrement in pH. In these terms a solution has a buffer value of one, when a liter will take up one gram equivalent of strong alkali or acid per unit pH. We shall also introduce the term pseudo-buffer capacity to apply to cases where the acid is weak. Van Slyke likewise showed that the maximum buffer capacity occurred at a pH-value equal to the pK value of the acid (or in the case of salt, the pK of its corresponding acid). The buffer value drops to 33% of its maximum at 1 pH unit from the maximum and to 4% at 2 pH units from the maximum. The buffer capacity is an additive property.

Skeins of wool were boiled for one hour with various proportions of the following:

(a) Sodium acetate and sulfuric acid, Fig. (67).

(b) Disodium phosphate and phosphoric acid, Fig. (68).

(c) Sodium acetate and acetic acid, Fig. (69).

Figs. (70) to (72) are the corresponding buffer capacity and pseudo-buffer capacity curves.

The buffer capacity curves, following Van Slyke's definition, are obtained by taking the tangent to the titration curves at various points with a tangentimeter[12] and using the necessary factors for conversion. Phosphoric acid is considered a monobasic acid below pH 6.0. From there to higher pH values, its dissociation as a diabasic acid is taken into consideration.

Examining the buffer capacities of the two systems, containing sodium acetate Fig. (70), and disodium phosphate Fig. (71), it is seen that:

(a) Excellent buffer capacities can be secured at extremely high concentrations, in these cases 50%, but the cost would be high, except for standing baths.

(b) There are maxima in the region of pH 4.7 for sodium acetate and pH 6.7 for disodium phosphate. These are the same as the maxima in systems without wool. If the salt concentrations were of the same molarity, the heights of the maxima would be the same.

(c) Wool has a considerable buffer capacity itself. It can be measured by the difference between the ordinates of the curves of wool with acid only and the curves of acid without wool. Below pH 3.0, the buffer capacity of wool increases extremely rapidly, so that no additional buffering is necessary in this region. This accounts for the ease and reproducibility of low pH values with the metallized dyes normally dyed at about pH 2.0.

(d) The region near the maximum buffer values is not very wide and may be passed with an excess of acid.

The pseudo-buffer capacity of acetic acid and wool alone, Fig. (72) is quite high below pH 4.5 and its pseudo-buffer capacity compares very favorably with the buffer capacity of strong acids with large amounts of buffering salts. Of course, additional buffering with salts derived from acetic acid can be obtained.

The principle involved in the use of acetic acid can be applied to other weak acids. After determining the pH at which to operate, an acid whose pK value is somewhat higher (above 0.5 unit) in value is chosen. An excess of such an acid over the required amount will change the pH very little and permit the maintenance of pH range within narrow limits. It has the further advantage of avoiding large quantities of extraneous buffer salts. For example, if we take uric acid with a pK of 5.8 and boil wool for an hour with

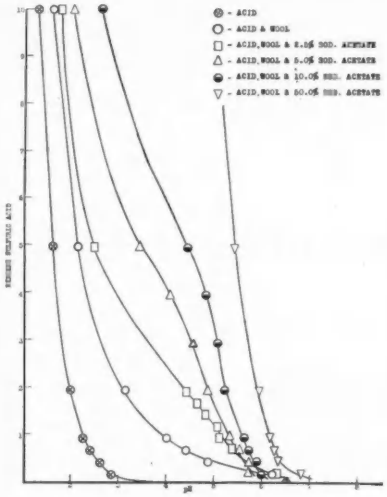


Figure 67

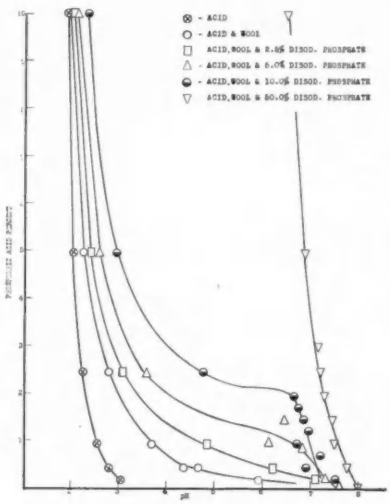


Figure 68

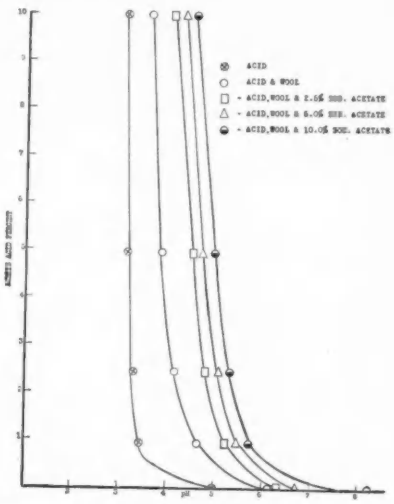


Figure 69

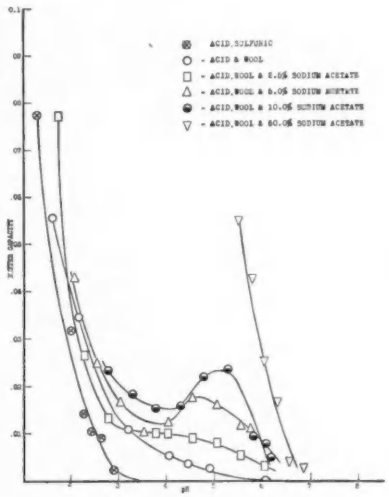


Figure 70

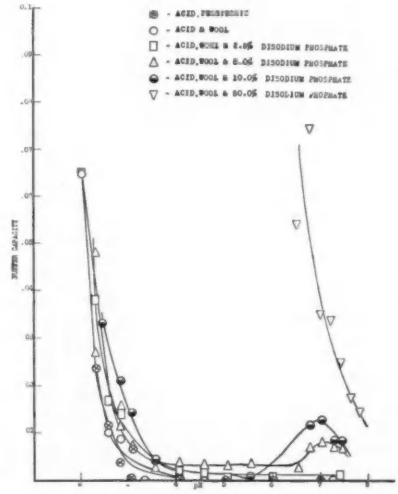


Figure 71

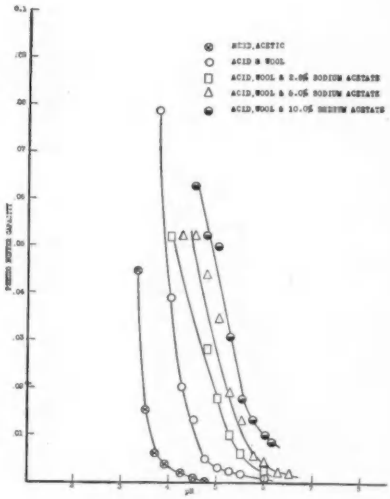


Figure 72

4% of it, we obtain a pH of 5.4.

The practical solution to the problem of maintaining pH in dye baths within narrow limits, lies in the selection of acids with proper pK values rather than with buffer salts.

Dyeing Rates

Practically all work in connection with dyes has been from an equilibrium standpoint. Boulton, Delph, Fothergill and Morton[10] felt that "possibly the most important factor to be considered in the dyeing process is speed". Royer, McCleary and de Bruyne[11] have given initial dyeing rates in percent per minute in dyeing viscose. In this study, we shall consider the rate in percent per minute based on the total amount absorbed at the end of 60 minutes. New dyeing curves were constructed, using the amount of dye absorbed at the end of 60 minutes as 100%. The rate curves are derived by obtaining the tangent of these new dyeing curves with a tangentimeter.

The colors used for comparison were Azo Rhodine 6B as a representative of the equalizing type and Alizarine Blue Black B as an example of the milling type. Their dyeing curves are shown in Figs. (73) and (74). The rate curves are shown in Figs. (75) and (76).

The most striking fact is the extremely high speed with which the dyes are absorbed in the first few minutes. These rates are so high that those above 10 percent per minute are not shown on the graphs.

The initial dyeing rates in these two instances are shown in Table II.

TABLE II

Initial Dyeing Rates

pH	*Azo Phloxine 6B*	*Aliz. Blue Black B*
2.6	57	—
3.6	38	—
4.6	19	89
5.6	3	57
6.6	—	38
7.6	—	8
8.6	—	7

In all cases, with increasing acidity, the rate is accelerated. The initial rates of the equalizing dye are much slower at the same pH than the milling type.

The importance of the rate curves in analysis can be illustrated in the rate curves of Polar Green CG and Alizarine Blue Black B at pH 6.6 in Fig. (77). Although both colors have identical exhaus-

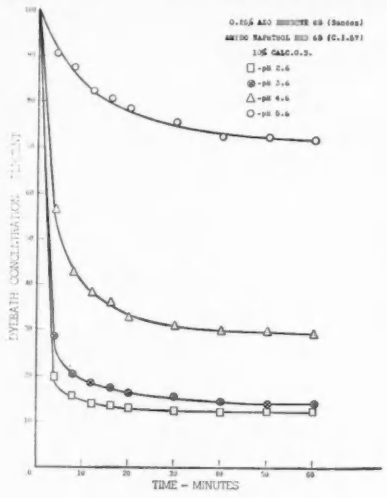


Figure 73

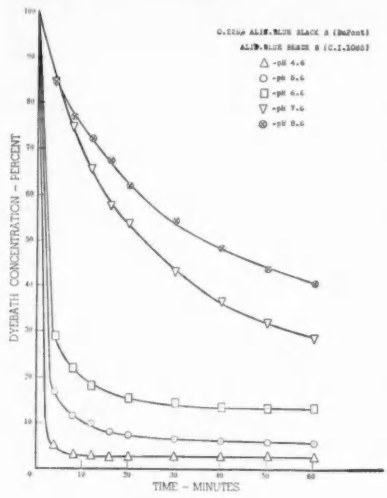


Figure 74

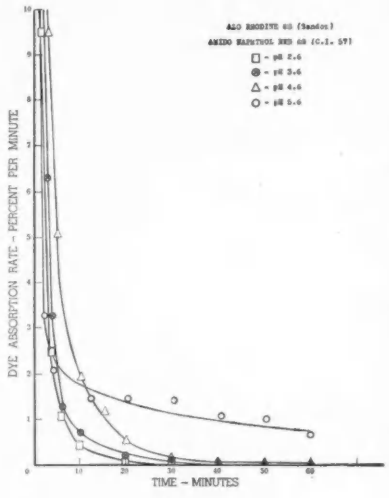


Figure 75

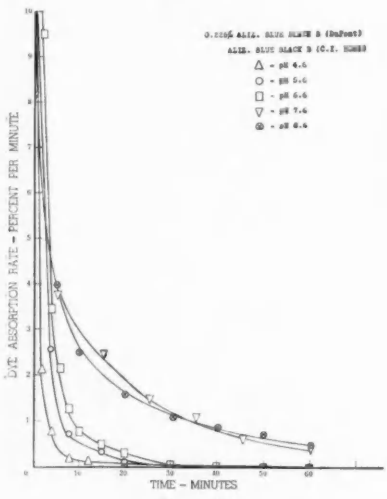


Figure 76

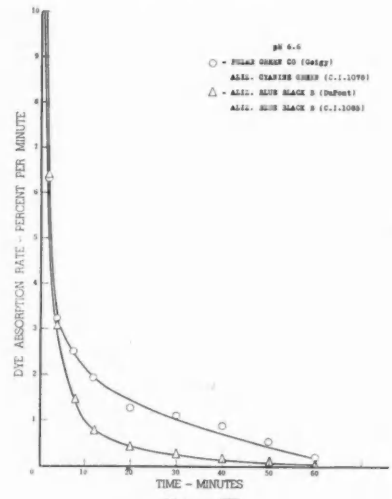


Figure 77

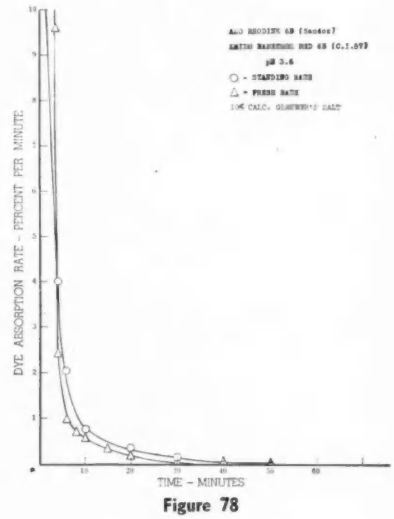


Figure 78

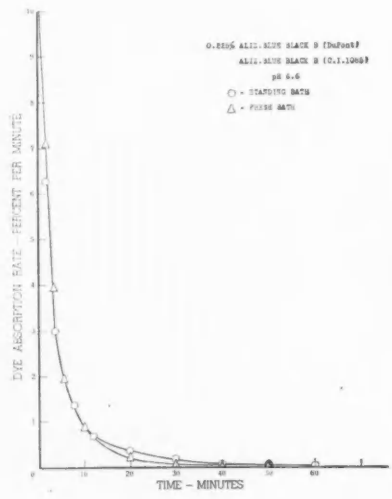


Figure 79

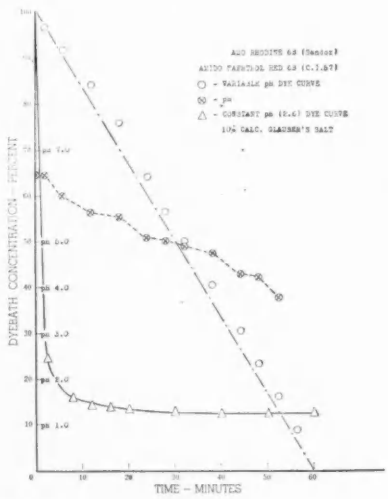


Figure 80

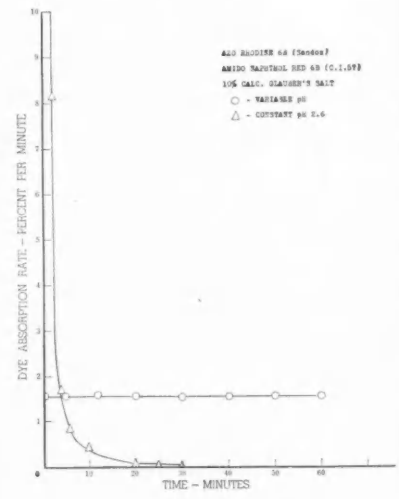


Figure 81

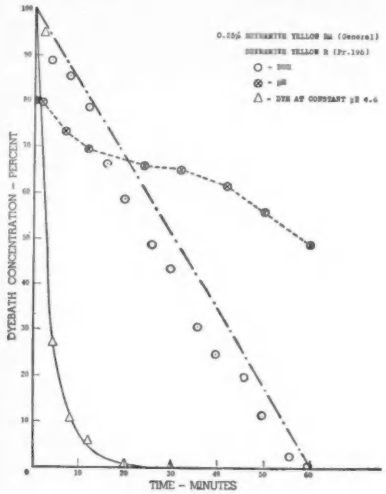


Figure 82

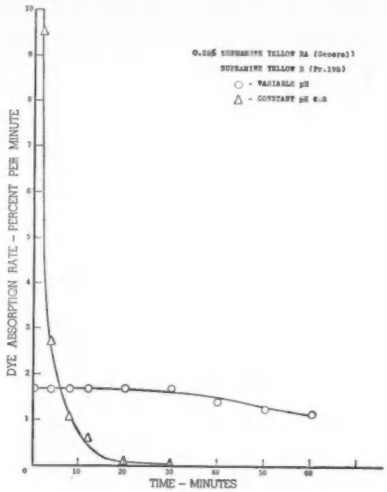


Figure 83

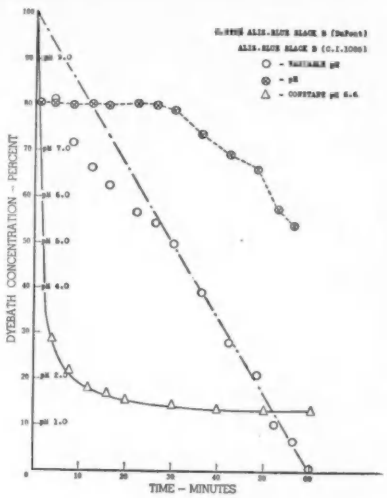


Figure 84

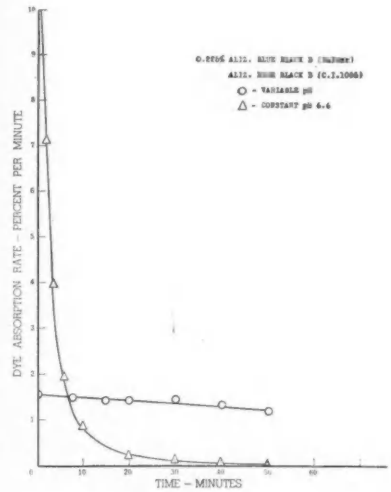


Figure 85

tion at the end of one hour, the rate curves are quite different. It becomes obvious why Polar Green CG is such a good shading color.

The rate curves were also used to investigate an old dyeing legend that standing baths dye more level than fresh ones. For this, some dye liquor was procured which had eighteen dye lots processed in it. No Glauber's salt was added after the first bath. Dyeings were made with the two types of dye using this bath. Two rate curves are shown in Figs. (78) and (79). There is no significant difference in the two rates of dyeing.

Uniform Rate of Dyeing

A casual inspection of the dyeing curves will show that very frequently as much as 50% of the dye is absorbed in the first two or three minutes. This is the reason the dyer must resort either to lower temperatures at the start or to intermittent additions of acid during the dyeing process.

Numerous dyers when asked how they would like to control the rate of dyeing, replied that the ideal rate would be a uniform one, where the dye is absorbed at a constant rate. If 60 minutes were the operating time, for example, the rate would be 1.67% per minute. At this rate, the dyeing would be a straight line starting at 100% and extending toward zero % at 60 minutes, if the dye were completely absorbed. This arbitrary rate is chosen in this particular study; any other rate could be used and the same principles applied.

To see how this would operate, an easily controllable dyestuff, Azo Rhodine 6B, was taken and a predetermined dyeing curve based on 100% absorption was made as shown by the straight line in Fig. (80). As the dyeing progressed, acid was added to keep the dyeing near the predetermined line. The dyeing curve at constant pH is also shown in Fig. (80). Rate curves are shown in Fig. (81).

The dyeing curve and rate curve of an intermediate dyeing color, Supramine Yellow R, is shown in Figs. (82) and (83).

A similar experiment is shown with Alizarine Blue Black B in Fig. (84) and the rate curve in Fig. (85).

A study of the two dyeing curves shows that the equalizing dyes can be made to follow the predetermined line very accurately. The milling dye curve can also be made to follow the predetermined line very accurately after a time and is never far away from it. The dyeing curves at constant pH are far apart from the predetermined line and this is accentuated in the rate curves.

Batch unlevelness is generally recognized as being due to irregular absorption during some part of the dyeing cycle. If this irregular absorption is eliminated, it opens the possibility of adjusting the slope of the straight line to a more rapid rate of dyeing, and obtaining good dyeings within a shorter time.

The noteworthy feature is that the pH curve of the equalizing dyes follows approximately a straight line as does that of the milling dye as soon as the dyeing curve reaches the predetermined line.

Conversely, the pH curve should be made to follow approximately a straight line in order to obtain a uniform rate of dyeing. Thus the dyeing can be checked or controlled by pH instruments to insure uniformity of dyeing.

Acid Forming Compounds

In the preceding experiments, numerous small additions of acid were necessary to keep the dyeings at a uniform rate. It would be much more convenient and practical if the proper acidity could be developed in the bath.

Ammonium sulfate and ammonium acetate have been used near the neutral point where pH values close to 7.0 are needed. Their range is, however, very limited.

To expand this range, an investigation of numerous acid and acid forming compounds was undertaken.

Aqueous solutions were made containing 0.1 % (weight to volume) of the acid-forming material. The pH of the solution was taken at 25° C; the solution was boiled for one hour, brought to the original volume and temperature and the pH taken at 25° C. The results are shown in Table III. As a matter of interest some alkaline forming compounds are included.

Table III

Chemical	Original	After Boiling	Difference Acid	Difference Alk.
Acetamide (C)	3.95	4.92		0.97
Acetin	4.62	4.57	0.05	
Acetyl p-aminophenol (C)	3.66	4.71		1.05
Acetylsalicylic Acid	3.19	2.84	0.35	
Mixed Alkane Sulfonic Acid	1.94	1.96		0.02
p-aminodimethyl aniline sulfate (C)	3.55	3.61		0.06
Ammonium Acetate	6.94	5.51	1.43	
Ammonium Chloride	5.80	4.13	1.67	
Ammonium Citrate	5.39	5.15	0.24	
Ammonium Hypophosphite	5.08	4.06	1.02	
Ammonium Nitrate	5.72	4.40	1.32	
Ammonium Oxalate	6.51	5.20	1.31	
Ammonium Persulfate	3.99	2.22	1.77	
Ammonium Phosphate Dibasic	8.15	5.06	3.09	
Ammonium Phosphate Primary	5.10	4.23	0.87	
Ammonium Sulfate	5.81	4.02	1.79	
Aniline Hydrochloride (C)	3.49	2.71	0.78	
Benzal Chloride (C)	2.88	2.39	0.49	
Benzene Sulphonyl Chloride (C)	2.71	2.05	0.66	
m-benzenedisulfonic acid (C)	2.26	2.22	0.04	
Benzenesulfonic acid (C)	2.40	2.35	0.05	
Benzonitrile (C)	4.60	4.52	0.08	
Benzotrichloride (C)	3.51	2.84	0.67	
Benzoyl Peroxide (C)	4.52	3.58	0.94	
t-butyl hydroperoxide (C)	4.86	5.39		0.53
n-butyl phosphate (C)	5.30	4.96	0.34	
Cetyldimethylethyl Ammonium Bromide (C)	6.07	4.78	1.29	
Cetyltrimethyl ammonium Bromide (C)	4.94	4.69	0.25	
Chloroacetal (C)	4.65	4.52	0.13	
Cholracetamide (C)	4.22	3.54	0.68	
Chloracetyl Chloride (C)	1.95	1.96		0.01
Chloral Hydrate	5.70	3.78	1.92	
o-chlorbenzylchloride (C)	5.49	3.89	1.60	
o-chlorobenzaldehyde (C)	3.36	3.51		0.15
o-chlorotoluene sulfonate sodium (C)	5.11	4.71	0.40	
Diacetin	4.8	4.38	0.42	
2,5 Dichlorobenzenesulfonic Acid (C)	2.61	2.65		0.04
2,4 Dichlorobenzoyl Chloride (C)	3.25	2.28	0.97	
Diglycol Chloroformate (C)	2.22	2.27		0.05
Diethyl Oxalate (C)	3.94	2.84	1.10	
Diethyl Sulfate (C)	2.69	2.22	0.47	
Dimethylaniline Hydrochloride (C)	4.54	4.26	0.28	
2,4 dinitro-1-naphthol-7-sulfonic acid (C)	2.54	2.65		0.11
Diphenyl p,p' disulfonic acid	2.46	2.54		0.09
Epichlorhydrin (C)	5.74	4.56	1.18	
Ethylchloroformate (C)	2.41	2.24	0.17	
Ethylene chlorohydrin anhydrous (C)	5.47	4.01	1.46	
Ethylene diacetate (C)	5.23	4.77	0.46	
Ethylidene Chloride (C)	5.69	5.67	0.02	
Ethylidene diacetate (C)	3.89	3.80	0.09	
Ethyl Acetoacetate (C)	5.00	4.12	0.88	
Ethyl Acid Phosphate (C)	2.33	2.37		0.04
Ethyl Bromide	5.76	4.42	1.34	
Ethyl Formate (C)	3.85	3.91		0.06
Ethyl lactate (C)	4.68	4.36	0.32	
Formamide (C)	5.56	5.66		0.10
Formin (Hexamethylenamine)	6.39	6.74		0.35
Glutamic acid hydrochloride	2.70	2.54	0.16	
Glycine (Aminoacetic Acid)	6.01	6.00		0.01
Glycol Diacetate (C)	5.41	4.65	0.76	
Glycerol dichlorohydrin (C)	3.81	3.80	0.01	
Glycol Diformate (C)	4.39	2.83	1.56	
Guanidine Hydrochloride (C)	2.61	2.50	0.11	
Guanidine nitrate (C)	4.94	4.90	0.04	
Guanidine Sulfate (C)	5.19	5.12	0.07	
Hexachlorobenzene (C)	4.71	4.20	0.51	
Hydroxylamine Hydrochloride 0.1 gm. and Formaldehyde 0.1 cc.	2.21	2.30		0.09
Lauryl pyridinium chloride (C)	4.97	4.50	0.47	
Loralklyl Acid Phosphate (C)	3.40	3.31	0.09	
Maleic Anhydride (C)	2.32	2.39		0.07
Malonamide (C)	5.24	4.90	0.34	
Methyl Acetoacetate (C)	4.72	4.42	0.30	
Methyl Acid Phosphate (C)	2.33	2.25	0.08	
Methyl formate (C)	5.20	4.12	1.08	
Methyl Parahydroxy Benzoate (C)	4.85	5.31		0.46
Methyl Sulfate (C)	2.54	3.86		1.32
2, Naphthalamine 6,8 disulfonic acid (C)	2.47	2.54	0.07	
2-nitro-ethyl 1,2 propanediol (C)	5.05	5.06		0.01
Nitromethane (C)	4.12	4.15		0.03
N-Octyl Acid Phosphate (C)	2.86	2.84	0.02	
Oxalyl Chloride (C)	1.75	1.79		0.04
Oxonamide (C)	5.42	4.86	0.56	
Phenacyl chloride (C)	5.60	3.83	1.77	
Phenyl acetonitrile (C)	5.16	5.36		0.20
Phthalimide (C)	5.34	4.34	0.91	
Phthalyl Chloride (C)	2.44	2.10	0.34	
Potassium Persulfate	3.92	2.45	1.47	
Propionyl chloride (C)	2.11	2.26		0.15
N-Propyl Acid Phosphate (C)	2.41	2.44		0.03
Pyridine hydrochloride (C)	3.66	2.78	0.88	
Sodium and Ammonium Phosphate	7.91	6.36	1.55	
Sodium Bicarbonate	7.02	8.44		1.42
Sodium Formaldehyde Sulfoxylate (C)	4.74	3.41	1.33	
Sulfamic Acid (C)	2.26	2.31		0.05
Sulfanilic Acid	2.91	2.89		0.02
Sulfathiazole	5.01	4.43	0.58	
4-sulfophthalic Anhydride (C)	2.39	2.50		0.11
Sulfosalicylic Acid	2.49	2.62		0.13
Thymol sulfonic acid (C)	2.58	2.61		0.03
Triacetin (C)	6.09	5.10	0.99	
Triphenyl guanidine	5.46	3.48	1.98	
Triethylamine 0.3 cc. Sulfuric acid (1:4) 0.3 cc. (C)	2.31	2.35		0.04
Urea (C)	5.80	8.51		2.71

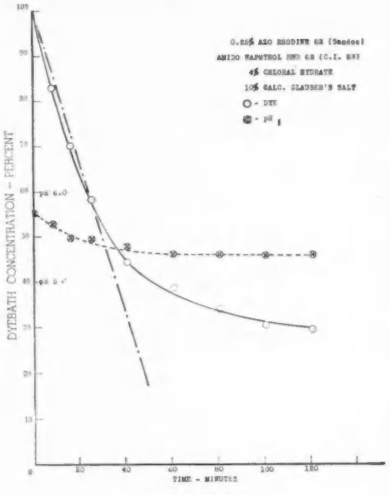


Figure 86

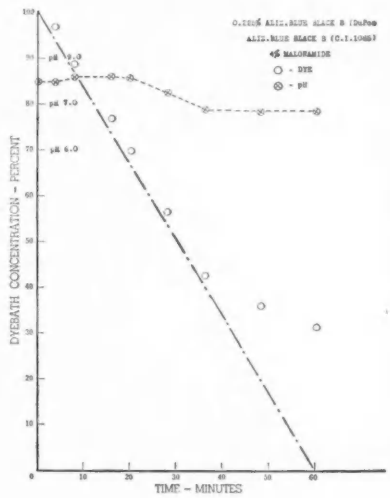


Figure 87

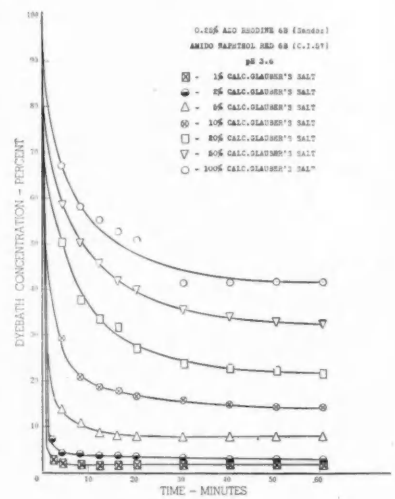


Figure 88

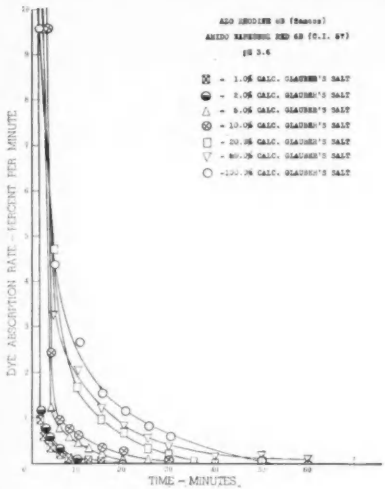


Figure 89

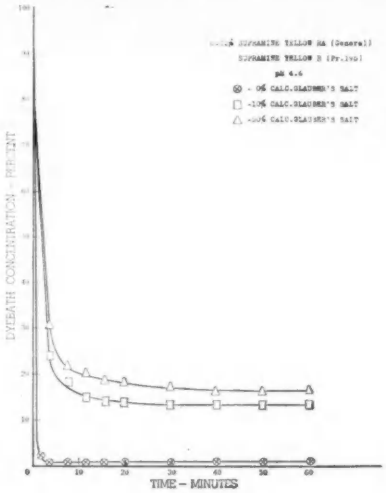


Figure 90

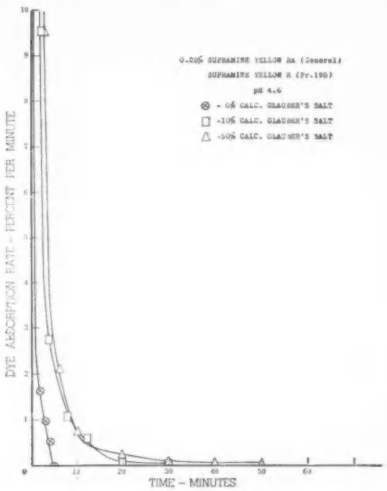


Figure 91

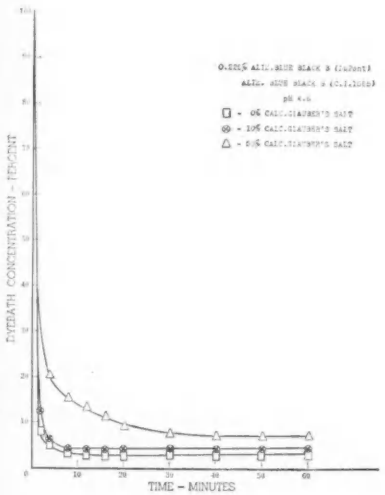


Figure 92

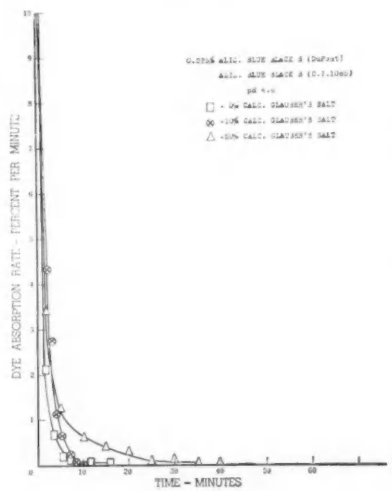


Figure 93

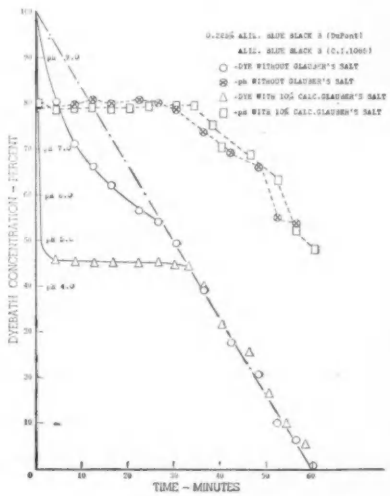


Figure 94

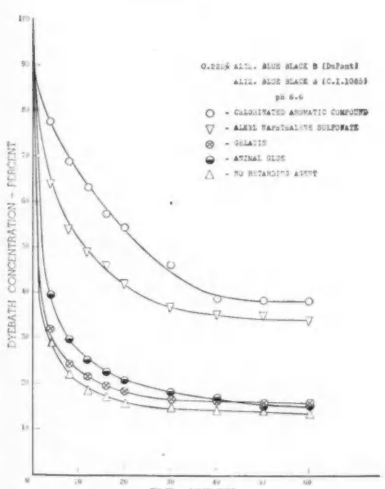


Figure 95

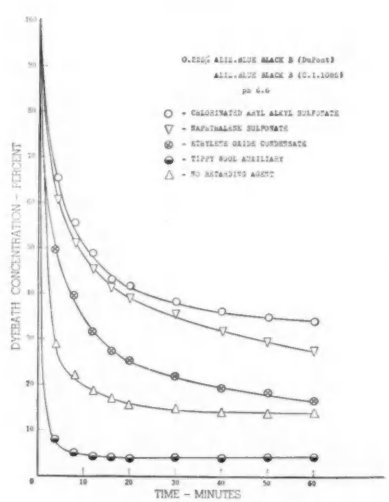


Figure 96

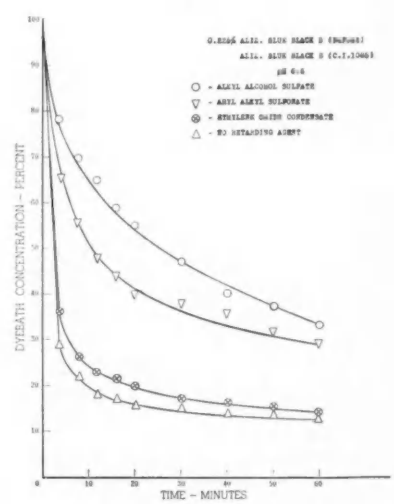


Figure 97

Table IV

Chemical	Percent on Weight of Wool	Orig. pH	pH After Boiling 15 Min.	30 Min.	45 Min.	60 Min.	pH Differ. Acid	Alk.
Urea (C)	0.5	8.35	7.85	7.9	7.7	7.7	0.65	
"	1.0	8.2	8.05	7.9	7.8	7.7	.5	
"	2.0	8.3	8.25	8.1	7.9	7.75	.55	
"	4.0	8.3	7.9	7.9	7.75	7.8	.5	
Oxonamide (C)	0.5	8.35	7.95	7.6	7.3	7.1	1.25	
"	1.0	8.5	8.05	7.6	7.5	7.2	1.3	
"	2.0	8.4	8.1	7.75	7.5	7.25	1.15	
"	4.0	8.45	8.05	7.75	7.2	7.0	1.45	
Malonamide (C)	0.5	8.35	7.65	8.0	7.9	7.6	.75	
"	1.0	8.3	7.95	8.0	7.9	7.55	.75	
"	2.0	8.2	8.05	7.9	7.9	7.7	.5	
"	4.0	8.6	8.2	7.9	7.9	7.7	.9	
Ammonium Sulfate	0.5	8.15	7.5	6.9	7.15	6.95	1.2	
" "	1.0	7.85	7.4	7.0	7.8	6.7	1.15	
" "	2.0	7.5	7.3	7.0	6.9	6.75	.75	
" "	4.0	7.35	7.1	6.75	6.8	6.7	.65	
Acetin (C)	4.0	8.2	7.35	6.5	6.25	5.5	2.7	
Diacetin (C)	4.0	7.7	6.6	6.2	6.0	5.3	2.4	
Ethyl Acetoacetate (C)	4.0	7.9	7.6	7.3	7.3	7.3	.6	
Glycol Diacetate (C)	4.0	7.5	7.5	7.2	6.6	6.4	1.1	
Epichlorhydrin (C)	4.0	7.7				5.95		
Sodium Bicarbonate	0.1	8.5	8.5	8.5	8.5	8.5		.0
" "	.25	7.8	8.4	8.7	8.8	8.9		1.1
" "	1.0	7.5	8.7	8.6	8.8	9.0		1.5
" "	4.0	8.6	9.1	9.4	9.4	9.3		.7
Diethyl Sulfate (C)	4.0	3.1	3.4	3.4	3.4	3.4		.3
Ethyl Acetoacetate (C)	4.0	8.6	7.9	8.0	7.7	7.5	1.1	
Glycol Diformate (C)	4.0	4.8	4.2	4.0	3.85	3.8	1.0	
Phthalimide (C)	4.0	6.25	5.4	4.3	5.3	5.3	.95	
Cetyl Dimethylethyl Ammonium Bromide (C)	4.0	5.55	5.1	5.1	5.2	5.2	.35	
Sodium-Toluene Sulfonate (C)	4.0	7.3	7.1	7.1	6.95	7.0	.3	
Acetamide (C)	4.0	8.9	8.3	8.15	7.6	7.7	1.2	
Ethylene Diacetate (C)	4.0	7.85	6.7	6.2	5.7	5.8	2.05	
Ethyl Formate (C)	4.0	7.0	5.95	5.8	5.7	5.8	1.2	
Triacetin (C)	4.0	7.0	6.2	5.8	5.75	5.65	1.35	
Chloral Hydrate	4.0	6.2	4.7	4.4	3.9	3.8	2.4	

(C) denotes commercial grade

From the results of this list a number of skeins of wool were treated at the boil with various percentages of each of a number of the compounds in Table III.

The results are shown in Table IV.

It will be seen from the last column in Table IV that the pH of the solutions change as much as 2.7 units.

From table IV, chloral hydrate, one of the compounds showing a great change in pH was taken to illustrate the effect of its use in dyeing an equalizing color. The result using four percent of chloral hydrate is shown in Fig. (86). The dyeing curve remains close to the predetermined line up to 50% of the exhaustion, then exhausts more slowly up to a final exhaustion of 70%. This is a long range to be attempted by one chemical and a stronger acid or acid forming compound would be added at 50% exhaustion.

In Fig. (87), is shown the effect of 4% malonamide on a milling type dye. It is seen that the dyeing curve follows the predetermined line up to 57% exhaustion. From then on another compound would be added to continue the dyeing along the straight line as before.

It may be mentioned that these acid forming compounds can be adjusted in their effect by changing the percentage used and various ones used to fit the type of dye.

The compounds have been chosen to illustrate the point and are not necessarily the most economical.

Other Means of Chemical Control

While the control of the acid dyebath is most readily accomplished by means of pH, there are other chemical factors which must be considered.

One is the effect of Glauber's salt in dyeing. The effect of increasing the Glauber's salt concentration on an equalizing dye is shown in Fig. (88) and the rate curves in Fig. (89).

On an intermediate dye, the dyeing curves are shown in Fig. (90) and the rate curves in Fig. (91).

On a milling type dye, the dyeing curves are shown in Fig. (92) and the rate curves in Fig. (93). This is in accordance with the work of Steinhardt, Fugitt and Harris[13], who state that with dyes of relatively low affinity, no better competition is needed than that now afforded by the addition of Glauber's salt.

With dyes of greater affinity, Glauber's salt exerts a progressively smaller effect. Recourse must therefore be had to the use of materials which have somewhere near the same affinity for wool as the milling type dyes.

The effect of Glauber's salt on a milling color in the early stages is shown in Fig. (94), where dyeings were made with and without Glauber's salt. The dyeing curve with Glauber's salt is initially much further away from the predetermined line, while the dyeing curve without Glauber's salt is much nearer and therefore indicates a more uniform rate of dyeing.

The effect of Glauber's salt is thus most powerful on the equalizing dyes, and less so with intermediate dyes. With milling type dyes its effect is small and may even be harmful in the early stages of the dyeing.

In Fig. (95), (96) and (97) are shown some other compounds whose effect on the dyeing and dyeing rates were studied.

The retarding effect of these compounds varies considerably, and in some cases is quite noteworthy. The ones with the greatest retarding effect bring the dyeing curves reasonably close to the predetermined line, even at pH 6.6. It is within the realm of possibility that products now being synthesized may permit a completely uniform rate from the start.

Summary

At higher percentages, sulfuric acid redistributed itself quite readily, but this is not true at lower percentages. Acetic acid transfers readily in any percentage in general use and is not replaceable by sulfuric acid in weakly acid baths.

Buffer salts were investigated, but the use of acids of suitable pK value was found to be superior.

A means of controlling the rate of both equalizing and milling types of dyes is possible. Dyestuffs may be classified by numbers on the basis of their absorption curves. This, however, merely facilitates the selection of dyestuffs of similar dyeing characteristics at specific pH values.

Controlling the rate of dyeing will result in uniform absorption of colors so grouped in a minimum of time. The data further show that a predetermianed line representing an ideal dyeing situation can be approached by means of chemical control. This is done by decreasing pH at a constant rate. The use of acid-forming salts is shown to have a wide range of application in this respect.

The same method of analysis can be applied to all types of dyeing and fibers.

References

[1] Noble—American Dyestuff Reporter, *34*, 19, 359 (1945).
[2] Goodall—American Dyestuff Reporter, *36*, 14, 380 (1947).
[3] Noble—Textile Journal of Australia, April, 1944.
[4] Goodall—Jour. Soc. Dyers & Col. *54*, 2, 46 (1938).
[5] Briggs and Bull—Jour. Phys. Chem., *26*, 845 (1922).
[6] Elod—Trans. Faraday Soc. *29*, 327 (1933).
[7] Barritt—J.T.I. *26*, 3, March 1935 T87.
[8] Goodall—American Dyestuff Reporter, *36*, 14, 384 (1947).
[9] Van Slyke—J. Biol. Chem., *42*, 525 (1922).
[10] Boulton, Delph, Fothergill and Morton—J. Text. Institute *24*, 113 (1940).
[11] Royer, McCleary and du Bruyne—Textile Research Journal, *17*, 8, 438 (1947).
[12] Latshaw—J. Chem. Soc. *47*, 793 (1925).
[13] Steinhardt, Fugitt and Harris—N.B.S., *28*, 201 (1942) R.P. 1453.

Acknowledgment

In the preparation of this work, we wish to acknowledge assistance received from the following:

Brehm & Stehle.
Calco Chemical Division, American Cyanamid Company.
Continental Mills.
E. I. duPont deNemours & Co., Inc.
James Lees & Sons Co.
Philadelphia Textile Institute.
Sandoz Chemical Works, Inc.
John B. Stetson Co.

Notice to Authors of Papers

MANUSCRIPTS for the Proceedings and for other publications of the American Association of Textile Chemists and Colorists shall conform to the requirements and standards given in this *Notice*, which was drawn up after study of similar notices for other journals, especially of the Notice in the *Journal of the American Chemical Society*. Before publication, manuscripts shall be approved by the Board of Editors, not only for editorial correctness according to the standards of this *Notice*, but also for content of technical matter. In its work, the Board may enlist the aid of anonymous reviewers who are selected for expert knowledge in particular fields.

It is presumed that authors in studying the comments of reviewers and editors will remember that all recommendations are made in a kindly, helpful, sympathetic manner to improve the paper in both literary and technical excellence. Although authors should cheerfully consider suggestions from reviewers and editors, they are expected to defend their position if justified, especially when strictly technical matters are involved with which the authors have an intimate knowledge.

MANUSCRIPTS.—Manuscripts shall be typewritten double-spaced with approximately one-inch margins on 8.5 x 11-inch white paper. In addition to the original, at least two carbon copies are required. Pages are to be numbered consecutively with Arabic numerals and each page after the first shall carry the authorship at the very top. Tables and figures shall also be numbered consecutively, the tables with Roman numerals as Table I, Table II, etc., and the figures with Arabic numerals as Fig. 1, Fig. 2, etc. The names of the authors and their laboratories or business connections should appear below the title of the paper.

LITERARY STYLE AND FORM OF PRESENTATION.—In the writing of papers, authors are requested to observe a trenchant, simple style of writing directed to textile chemists and colorists with at least an elementary knowledge of chemistry, physics, mathematics, engineering, textile processes and textile machinery.

In the organization of the material, there should be one or more introductory paragraphs setting forth the occasion, significance and main objectives of the paper and of the method of attack. This should be followed by the body of the presentation, either with discussions interspersed throughout this portion or with a collected section marked "Discussion" after the main body of the paper. Finally, there shall be a brief section at the end entitled "Summary" or "Conclusion". A separately written abstract of not over 200 words shall accompany every manuscript.

Center headings should be employed sparingly and generally will include only very important section headings such as "Introduction", "Experimental", "Discussion", "Conclusions", and "Summary". Side headings (see third paragraph of this *Notice* for an example) shall be indented and run into the text to which they apply, using a period and dash. The publisher will print center headings in bold face type and side headings in capitals.

LITERATURE REFERENCES AND FOOTNOTES.—References to the literature and all footnotes (except those in tables) shall be numbered consecutively with Arabic numerals in parentheses at the proper place in the text. Where a reference or footnote is to be used again, the original number is simply repeated, thus obviating the necessity of repeating the footnote or reference at the bottom of the page. References to the literature shall conform to the universal usages followed by *Chemical Abstracts*.

The spelling and rules of punctuation followed in manuscripts shall be those found in the *Merriam-Webster New International Dictionary;* abbreviations and chemical formulas shall conform to *Chemical Abstracts*.

FIGURES AND GRAPHS.—Figures and graphs should be black line drawings on white drawing paper. Photographic prints are acceptable, preferably glossy prints on double-weight paper. Duplicates should be available for dispatch to reviewers. Diagrams and graphs should preferably be designed in long form to cover one column of print but may be two columns wide or the width of a full page where necessary. In graphs the frame and actual curves should be inked more heavily than the coordinate lines, and these latter should not be too close together. Various styles of broken lines are sometimes desirable to distinguish curves. Experimental points should be given with small plane figures, such as circles, squares, diamonds or triangles. Numbers and legends on coordinate axes are to be lettered in the graph by the author. Numbers and titles of figures should be placed below the diagram or on the edge of the back. Each piece of illustration copy should bear on the margin or on the edge of the back the name of the author and the title of the paper.

TABLES.—Tables should not be used indiscriminately because they are very expensive to set up in type. They should be designed to be one column, two columns or three columns wide. Tables should be arranged with the view of conserving space; column headings should be short and abbreviated. Quantity designations shall never appear in the body of the table but in the headings. Tables, if possible, should be placed in the manuscript where they belong rather than separately.

GALLEY PROOFS.—Galley proofs will be sent to the author by the publisher for correction before publication. This should not be interpreted as an invitation to rewrite the paper but rather as an opportunity to correct errors.

OWNERSHIP OF COPYRIGHTS AND PATENTS.—Any paper published in the Proceedings becomes the property of the Association as far as publication, re-publication and copyright are concerned. Any patentable disclosures shall of course remain the property of the author or authors.

Fundamental Research Group Meeting—

Studies on Nylon Dyeing

*Effect of Dyeing Procedures**

LOUIS I. FIDELL, GEORGE L. ROYER and HENRY E. MILLSON

Calco Chemical Division, American Cyanamid Company, Bound Brook, N. J.

Summary

Experimental methods of dyeing and microscopical examination have been applied in a study of the dyeing of nylon with acetate, acid, direct, metallized and crome dyes. The use of acetic, formic and sulfur acids in the application of these dyes to nylon has been investigated in general at practical concentrations, and it is shown that at lower pH values, the exhaustion is increased in all cases excepting the acetate dyes. Physical tensile data obtained on fabric and single nylon fibers show that at practical dye concentrations and values of pH not lower than 1.6 no appreciable deterioration of the nylon occurs in dyeing. A new term "preferential sorption" is introduced and defined with reference to the influence of one dye on the sorption of another, and data are given to illustrate this phenomenon. Examples of the effect of differences in the physical properties of nylon in dyeing behavior are also discussed briefly.

Introduction

THE techniques and methods previously developed *(1)* in our laboratories for the investigation of the dyeing of wool, rayon, and other fibers have been applied in this study to nylon. The penetration and location of dye in the fiber, determined by microscopical methods, and exhaustion data determined by a time-temperature technique, have been correlated with methods of application and the tinctorial values of the final dyeings.

Much of the early published work on the dyeing of nylon is general in character. The more specific and fundamental work done within the past few years has led to a better understanding of the subject. The introduction of nylon in fields where other fibers have been used, however, was accompanied in practice by a tendency to employ the same dyes and methods which had been used for those fibers, rather than to use new techniques based on experimental work with nylon. Acetate dyes are often used because of their leveling action, and simplicity of application, although other dyes whose application is more difficult would yield fastness properties superior in some respects. Vickerstaff *(2)* discusses the dyeing of nylon with these dyes from both the fundamental and technical viewpoints.

The importance of acid concentration in the dyeing of nylon has been pointed out previously *(3)*. It was shown that the presence of acid influences the rate of exhaustion, the penetration of dye into the individual fibers, and also the equilibrium and saturation exhaustion values. Boulton *(4)* and Peters *(5)*, also have reported results on the use of acid in nylon dyeing. In Peters' work, the subject is treated from a "theoretical"† point of view, securing data under equilibrium dyeing conditions. Boulton, in a "technical"† presentation, deals chiefly with the rate of dye absorption, apart from some equilibrium data presented for theoretical consideration.

In the present study an attempt was made to arrange the laboratory experiments and presentation of the data in a manner which would be most useful to the dyer, and which would reveal the progress of the dyeing action. The dyes for which data are given were chosen to include each classification used in practice at present.

The time intervals, temperatures, and the measurements of exhaustion and color value were chosen with reference to plant operation, to permit the practical application of the experimental results.

Material

The nylon used was parachute cloth, in which the warp yarns contained 23 filaments of 20-micron diameter and the filling yarns 34 filaments of 15-micron diameter. The weight of the fabric was 1.69 oz. per square yard, scoured and set. It is known that differences probably due to variations in physical treatment during the drawing and setting, exist in nylon as purchased, and influence its dyeing behavior. This may be the cause for lack of agreement in some of the published data. In this paper, all work except where noted was done on the same material, and therefore the results should be comparable. Since the material was obtained from normal commercial production, the data should be of practical value also.

Methods

For the time-temperature studies five grams of nylon fabric were used for each dyeing. One-half percent and 2% dyeings were made of each dye, with a dye bath volume to nylon ratio of 30:1. Each acetate dye was rubbed out with an equal weight of water and then diluted with warm water. One-half percent of Duponol WA Conc. and ¼% of tetra sodium pyrophosphate (on the total weight of nylon) were added as solutions and the whole diluted to make ten dye baths. The water-soluble dyes were boiled in water for a short time to insure solution, and were also diluted to make 10 dye baths. One bath from each series of ten was retained as a standard for spectrophotometric measurement of exhaustion. The remaining nine, after the addition of the nylon, were placed for the dyeing periods in Launderometers which had been modified for dyeing at temperatures up to the boil (See Fig. 1). The thermostat was set to raise the temperature 20° F. every 6 minutes. Each series of acetate dyeings was started at 100° F., and the jars were removed successively at 140° F., 160° F.,

* Presented at Fundamental Research Group Meeting, Dr. Leonard Armstrong, Presiding, National Convention, Chicago October 24, 1947.

† These terms are used in the sense of Vickerstaff's definition (*2*).

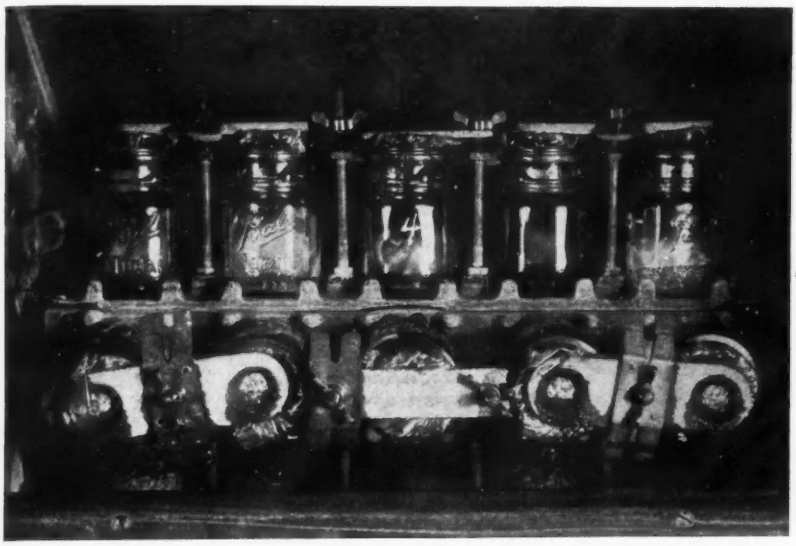


Figure 1

180° F., 200° F., and after a 10, 20, 30, 45 and 60-minute run at 200° F. The soluble dye series were started at 120° F., and jars were removed successively at 160° F., 180° F., 200° F., 212° F. and after 15, 30, 45, 60 and 90 minutes at 212° F. In addition to the dyeings carried out without acid in this manner, corresponding series were made with 2% acetic acid, 2% formic acid, and 2% sulfuric acid respectively on the weight of the nylon.

Immediately upon the removal of each jar, the nylon sample was rinsed and dried. After cooling to room temperature, the pH of the dye liquor was recorded, and the dye bath was diluted to a given volume for the measurement of dye content from spectrophotometric transmission curves obtained on a General Electric type recording spectrophotometer. The percentage exhaustion was calculated with reference to the original starting dye bath taken as the standard. The difference in dye content between the initial and final bath was assumed to equal the quantity of dye exhausted onto the nylon up to the time and temperature of its removal. In the case of the soluble dyes, the dye content was determined directly after cooling, while the acetate dye baths were observed after cooling and dilution with acetone and water (to contain equal volumes of each) to insure complete solution of the dye.

The reflectance of the samples of nylon removed at successive temperatures and times was also measured spectrophotometrically, using the techniques described by Stearns *(6)*. The reflectance curves obtained were interpreted as color value C_V by the use of the expression given for wool, in Stearns' paper. As a standard of comparison, one dyeing of each dye was selected, namely the dyeing of maximum color value without regard for the series (in which it was obtained). The color value C_V of this dyeing was rated as 100%, and C_V for all other dyeings of the same dye was expressed as a percentage of it. Exhaustion and color values indicate the efficiency of the dye application by various methods.

While the reason for poor color value due to poor exhaustion is clear, the less evident reason for poor color value with good exhaustion can often be demonstrated by microscopical techniques. These have been described by Royer, Maresh, and Harding *(7)*, and have been used in the previous studies referred to above *(1)*. In the acetate dye series, cross sections were made of warp yarns taken from the 2% dyeings at 160° F. and 200° F., and after 30 and 60-minute runs at 200° F. In the cases of soluble dyes, the 2% dyeings removed at 212° F. and after 30 and 90 minutes at this temperature were studied. Cross sections of the ½% dyeings were not made since in general the coloration of these fibers was not heavy enough to yield visible color in the sections. The cross-section studies provide information on the extent of penetration of the dye into the nylon fiber.

The exhaustion and reflectance data have been assembled in tables and for one dye plotted graphically. For example, Table I shows the data obtained for Calco Acetate Orange 6R. In Figures 2A and 2B, percentage exhaustion is plotted against time and temperature, while color values are similarly plotted in Figure 3. While the graphical method is more useful in the oral presentation of this paper, the tables only are included for publication, due to their more condensed form. The reprint of this paper as Calco Technical Bulletin No. 798 will contain the curves of all of the dyes studied, in addition to the tables.

Influence on Acids

In the application of acetate dyes to nylon, the effect of the pH of the dye bath appears to be minor. However, the application of other classes of dyes is markedly influenced by pH. The rate and extent of exhaustion and the penetration of the dye into the yarns and individual fibers varies considerably with the type and concentration of acid used. In order to study the effect of acid on the dyeing of nylon over a range of pH, it was decided to use the three acids commonly found in practical dyeings. The ranges of pH found with the 2% concentration of each acid is approximately as follows:

Acid	*pH Range*
None	7.6—8.8
Acetic Glacial)	3.5—4.5
Formic (90%)	3.0—3.4
Sulfuric (Conc.)	1.8—2.3

The results obtained with dyes of the acetate, acid, metallized, direct and chrome dye groups are described below.

Acetate Dyes

Calco Acetate Orange 6R Conc.

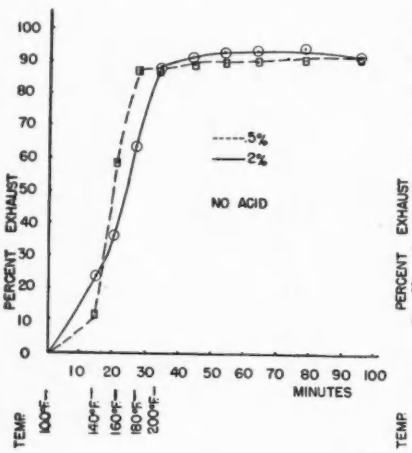
The effect of acids on the dyeing rate and the final exhaust appears to be small. See Table I, Figures 2A and 2B. The rate of exhaust of the no-acid dyeing is slightly less from 100°-140° F., but above 140° F. is comparable to that of the acid dyeings, which do not differ appreciably.

The reflectance data for this dye (Table I, and Figure 3) under the four dyeing conditions indicate that the effect of acid on its tinctorial value is small. Cross sections show that lowering the pH has little effect upon the diffusion of this dye into the nylon fiber. In all cases, fibers from the samples removed at 160 F. were very lightly ring-dyed. At 200° F. penetration had progressed much further, with only a small region at the center of the fiber remaining undyed. After running at 200° F. for 30 minutes all fibers were completely penetrated by the dye. Cross sections of the series without acid as shown in Fig. 4A, B and C are representative.

TABLE I

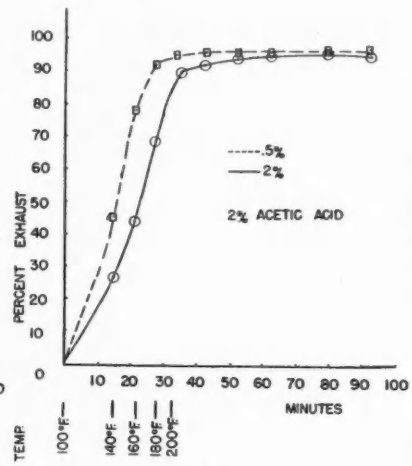
Calco Acetate Orange 6R Conc. C.I.#

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
1	To 140	15	8.50	11	18	3.65	46	21	3.00	46	23	2.20	70	23	8.40	23	28	3.45	27	28	3.10	39	33	2.25	54	31
2	160	21	8.40	58	32	3.70	77	32	3.00	71	32	2.20	78	33	—	35	50	3.45	44	54	3.20	52	50	2.25	64	54
3	180	27	8.45	86	42	3.70	92	43	3.05	91	40	2.20	88	39	8.45	63	67	3.45	70	75	3.20	61	73	2.25	67	62
4	200 At	33	8.50	86	47	3.75	94	49	3.10	93	47	2.20	90	46	8.50	87	91	3.45	89	94	3.25	87	92	2.25	87	92
5	200	10	8.50	—	48	3.75	94	50	3.20	95	47	2.20	93	46	8.50	91	92	3.45	92	95	3.25	94	93	2.25	92	93
6	"	20	8.50	89	48	3.75	95	50	3.15	95	48	2.20	93	47	8.70	92	93	3.45	93	96	3.20	94	94	2.25	93	94
7	"	30	8.50	90	49	3.75	96	51	3.15	95	49	2.20	93	47	8.75	90	94	3.50	93	97	3.20	95	94	2.30	93	94
8	"	45	8.60	90	49	3.75	96	51	3.20	95	49	2.20	93	47	8.75	94	95	3.45	94	99	3.25	94	94	2.30	94	93
9	"	60	8.70	91	50	3.75	96	52	3.20	95	50	2.20	93	48	8.85	91	96	3.50	94	100	3.25	94	95	2.30	94	95



A

Figure 2



B

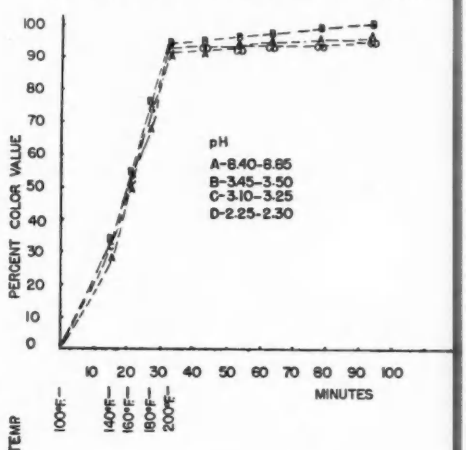
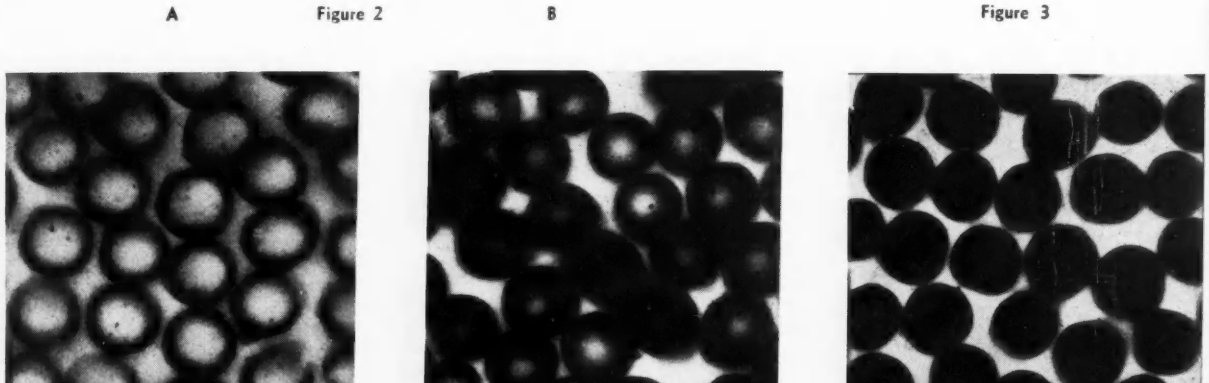


Figure 3



A B C

Figure 4

A—Calco Acetate Orange 6R Conc. (Without Acid) 160° F
B—Calco Acetate Orange 6R Conc. (Without Acid) 200° F
C—Calco Acetate Orange 6R Conc. (Without Acid) 200° F—30 minutes

Calco Acetate Sapphire Blue R

The presence of acid in the dye bath causes a slight increase in the rate of exhaustion of the ½% dyeings and a more marked increase in the case of 2% dyeings. These data are shown in Table II. The exhaustion values indicate that the presence of the acids also increases the amount of dye exhausted both at 200° F. and at the conclusion of the dyeing.

Reflectance data shown in Table II

TABLE II

Calco Acetate Sapphire Blue R C.I.—Pr. 228

Exp. No.	Time °F.	Time Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
1	To 140	18	8.0	21	7	4.3	21	9	3.25	29	10	2.20	46	11	7.90	15	11	4.35	23	14	3.30	20	16	2.35	35	18
2	160	23	7.8	46	14	4.3	50	13	3.25	70	18	2.20	68	16	7.20	22	24	4.40	32	25	3.35	41	30	2.35	58	26
3	180	29	7.4	71	24	4.4	75	25	3.25	76	26	2.20	86	27	6.50	28	45	4.40	53	47	3.30	57	46	2.40	76	50
4	200	35	7.3	83	29	4.4	89	34	3.25	91	34	2.20	91	34	6.90	45	67	4.45	74	76	3.30	80	85	2.30	85	85
5	At 200	10	7.35	87	30	4.4	91	35	3.25	93	35	2.20	92	37	7.20	68	91	4.45	83	92	3.30	90	93	—	92	86
6	"	20	7.50	88	31	4.4	91	36	3.25	92	36	2.20	92	34	7.10	74	92	4.75	89	94	3.30	91	96	2.30	92	90
7	"	30	7.60	88	32	4.4	92	37	3.30	94	36	2.20	92	35	7.40	79	93	4.50	90	96	3.30	90	97	2.30	92	92
8	"	45	7.70	89	34	4.4	91	38	3.30	92	37	2.20	92	36	7.65	80	94	4.50	90	98	3.35	91	98	2.30	92	93
9	"	60	7.85	89	35	4.4	91	35	3.30	94	38	2.20	93	36	7.95	82	95	4.50	90	99	3.35	92	100	2.25	93	94

TABLE III

Calco Acetate Brilliant Scarlet BN C.I.—Pr. 244

Exp. No.	Time °F.	Time Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
1	To 140	13	7.80	21	12	4.40	14	13	3.30	32	16	2.35	60	19	8.60	15	16	4.50	7	16	3.30	21	16	2.30	33	23
2	160	19	8.50	50	25	4.50	50	26	3.30	56	27	2.35	71	33	8.60	31	34	4.55	24	32	3.35	23	33	2.35	41	40
3	180	25	8.50	79	46	4.50	77	44	3.35	72	43	2.40	82	47	8.60	45	60	4.60	33	52	3.35	27	52	2.35	44	58
4	200	31	8.50	88	61	4.50	86	57	3.35	89	59	2.40	88	58	8.60	62	87	4.65	63	89	3.40	52	86	2.35	64	92
5	At 212	10	8.35	92	61	4.50	92	62	3.35	93	62	2.45	91	61	8.50	88	97	4.70	87	96	3.40	84	96	2.35	83	98
6	"	20	8.45	93	62	4.55	94	62	3.35	94	63	2.45	92	62	8.35	92	98	4.65	90	97	3.40	87	97	2.40	87	98
7	"	30	8.15	94	62	4.55	95	63	3.35	95	64	2.45	92	63	8.25	91	98	4.65	91	98	3.45	85	98	2.40	87	99
8	"	45	8.15	94	63	4.50	95	64	3.35	96	64	2.45	92	63	8.50	91	99	4.65	92	99	3.40	90	99	2.40	89	99
9	"	60	8.15	94	63	4.60	96	65	3.35	95	64	2.35	93	64	8.30	93	100	4.70	93	100	3.40	90	100	2.40	90	100

confirm the more rapid rate of dyeing with acid at both the ½% and 2% concentrations of dye, the acid dyeings reaching a maximum reflectance value ten minutes sooner than the dyeings without acid.

Cross sections of samples removed at 160° F. showed either no penetration or very light ring formation. At 200° F. the samples still exhibited ring-dyeing or very light penetration. After running at 200° F. for 30 and 60 minutes, all fibers showed complete penetration.

Calco Acetate Scarlet BN

The exhaust and reflectance data shown in Table III are sufficiently similar in the case of the 2% dyeings to indicate that acids have little if any effect upon the dyeing rate or exhaustion of this dye. Sulfuric acid, however, produces slightly greater color value during the early stages of dyeing.

Cross sections of fibers from all series showed similar characteristics, those removed at 160° F. being lightly ring-dyed, those removed at 200° F. heavily ring-dyed, while those run at 200° F. for 30 and 60 minutes were completely penetrated.

Acid Dyes

Calcocid Yellow MCG

In the absence of acid, this dye showed no exhaustion at any time or temperature. All of the acids, however, effected complete exhaustion of the ½% dyeings, while the 2% dyeings were poorly exhausted even with sulfuric acid, as shown by Table IV.

Since little if any dyeing is accomplished without acid, the reflectance values of these dyeings have no practical significance. With acetic acid both ½% and 2% dyeings show a slower rate of color development than with the stronger acids. However, the reflectance values of the dyeings boiled for 90 minutes are within 10% of each other. These data are in agreement with the information obtained from cross sections, in that the acetic acid dyeings removed at the boil exhibited ring formation while the formic and sulfuric acid dyeings removed at the same time are almost completely penetrated. In all cases fibers of the dyeings removed after boiling 30 and 90 minutes are completely dyed.

Calcocid Printing Red B Conc.

This dye shows practically no exhaustion at low temperatures with or without acid, as shown in Table V. Greatest exhaustion was obtained with formic acid in the ½% dyeings, and with acetic acid in the 2% dyeings, although in all cases the exhaustion was poor. Extended time at the boil appears to be necessary for proper utilization of this dye, and is more important than lowering the pH.

Reflectance data show that the best color values after 160° F. is reached are obtained with formic acid. Acetic and sulfuric acids give similar final color values, with the acetic acid dyeings developing more slowly.

The cross section of the no-acid dyeing removed at 212° F. showed no indication of dyeing, although after running 30 minutes or more at 212° F. very slight ring dyeing was noted. With all three acids heavy ring dyeing was observed in samples removed at 212° F. Fibers removed after 30 minutes run at 212° F. exhibited almost complete penetration of the dye with only a small central region remaining undyed. After 90 minutes run at 212° F. the fibers were heavily and completely dyed.

Calcocid Navy Blue 3R Conc.

When applied at ½% concentration without acid, the exhaustion of this dye was completed (99%) after 1 hour at 212° F., while at the same time the exhaustion of the 2% dyeing was only 50%. As shown in Table VI, the presence of 2% of acid greatly increased the exhaustion rate. In the case of acetic acid, the 2% dyeing was entirely exhausted after 15 minutes at 212° F., while formic and sulfuric acids produced even more rapid exhaustion. Unfortunately, with the latter two acids, the spectrophotometric curves indicated a change of shade in the liquor during dye-

TABLE IV

Calcocid Yellow MCG C.I.—640

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
	To																									
1	160	16	8.15	0	0	4.10	0	0	3.40	23	18	2.05	29	17	8.10	0	0	4.25	0	7	3.45	4	16	2.00	0	19
2	180	22	8.15	0	0	4.10	7	7	3.45	27	42	2.05	57	36	8.15	0	0	4.25	0	16	3.45	15	37	2.00	10	40
3	200	28	8.15	0	0	4.15	26	20	3.45	94	55	2.05	95	59	8.10	0	0	4.30	8	37	3.50	20	71	2.00	18	75
4	212	35	8.10	0	0	4.20	78	56	3.45	99+	56	2.00	99+	60	8.10	0	0	4.35	19	65	3.50	32	89	2.00	25	91
	At																									
5	212	15	8.00	0	0	4.25	99+	59	3.45	99+	59	2.00	99+	61	8.10	0	0	4.40	33	85	3.50	36	90	2.00	65	96
6	"	30	7.90	0	0	4.30	99+	61	3.45	99+	63	2.00	99+	62	8.00	0	0	4.40	35	86	3.55	40	91	2.00	65	97
7	"	45	7.90	0	0	4.35	99+	63	3.45	99+	64	2.00	99+	63	8.00	0	0	4.45	38	87	3.55	40	92	2.00	65	98
8	"	60	7.90	0	0	4.35	99+	65	3.50	99+	66	2.00	99+	65	8.00	0	0	4.45	35	88	3.55	40	94	2.05	65	99
9	"	90	7.50	0	0	4.35	99+	68	3.50	99+	68	2.00	99+	66	8.00	0	1	4.50	35	89	3.65	41	95	2.00	65	100

TABLE V

Calcocid Printing Red B Conc. C.I.

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
	To																									
1	160	13	8.00	0	0	3.90	0	4	3.10	0	6	2.15	0	6	7.75	0	0	3.90	3	5	3.00	0	8	2.00	0	15
2	180	19	8.00	0	0	3.90	0	12	3.10	8	22	2.15	0	17	7.75	2	2	3.90	6	13	3.00	2	30	2.00	0	28
3	200	25	8.00	3	0	4.00	3	25	3.00	17	35	2.15	8	28	7.70	2	3	4.00	8	42	3.00	2	51	2.00	3	45
4	212	31	8.00	3	0	4.00	17	33	3.00	42	43	2.15	21	37	7.60	3	3	4.00	20	56	3.05	10	74	2.00	16	55
	At																									
5	212	15	7.90	7	2	4.10	40	42	3.05	58	45	2.15	54	47	7.70	4	6	4.10	25	75	3.10	36	83	2.10	32	86
6	"	30	7.90	7	2	4.10	52	46	3.10	71	55	—	—	48	7.80	5	8	4.15	42	78	3.15	42	88	—	—	87
7	"	45	7.90	11	3	4.10	61	49	3.15	79	56	2.20	67	50	7.85	6	9	4.30	46	85	3.25	44	95	2.10	34	90
8	"	60	8.00	11	3	4.20	65	52	3.25	75	57	2.20	71	52	7.80	—	10	4.30	51	89	3.25	46	97	2.05	34	92
9	"	90	8.00	11	4	4.15	69	53	3.30	79	59	2.20	71	53	8.00	10	11	4.20	56	93	3.25	47	100	2.10	37	93

TABLE VI

Calcocid Navy Blue 3R Conc. C.I.—289

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
	To																									
1	160	13	8.00	8	6	3.75	—	13	3.00	RED	12	2.45	RED	14	8.10	10	7	3.90	12	10	3.10	RED	14	2.50	RED	12
2	180	19	8.10	8	10	3.75	—	32	3.00	"	30	2.45	"	35	8.10	10	10	3.95	12	23	3.10	"	40	2.50	"	39
3	200	25	8.05	23	17	3.85	GR.	54	3.10	GR.	50	2.45	GR.	49	8.15		16	4.00	37	55	3.10	"	75	2.50	"	75
4	212	31	8.10	50	32	3.85	"	57	3.10	"	49	2.45	"	50	8.20	14	21	4.05	66	75	3.10	"	87	2.55	"	89
	At																									
5	212	15	8.10	62	44	3.85	"	58	3.20	"	53	2.45	"	60	8.20	35	43	4.10	GR.	90	3.10	"	90	2.60	"	89
6	"	30	8.10	89	53	3.90	"	59	3.15	"	63	2.45	"	61	8.20	37	42	4.10	"	92	3.15	GR.	94	2.60	GR.	88
7	"	45	8.00	GR.	59	3.85	"	60	3.20	"	56	2.45	"	62	8.20	40	47	4.15	"	95	3.20	"	95	2.60	"	92
8	"	60	8.00	"	65	3.95	"	65	3.10	"	57	2.45	"	58	8.20	48	55	4.10	"	98	3.20	"	89	2.60	"	87
9	"	90	8.00	"	59	3.95	"	63	3.05	"	58	2.45	"	63	8.20	54	60	4.05	"	100	3.20	"	90	2.60	"	81

GR = Exhaust Greenish Blue
RED = Exhaust Red Blue
This dye cannot be accurately compared for exhaust values because of change in shade of the exhaust liquors as dyeing proceeds. The values are given at those points where the shade of the exhaust liquor produces a similar transmission curve to the original dye solution.

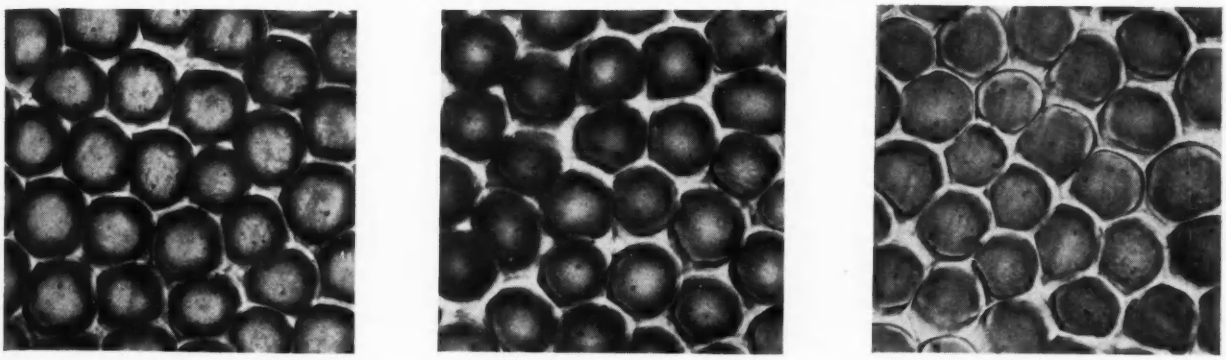
TABLE VII

Calcocid Alizarine Green CGN Ex. C.I.—1078

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
	To																									
1	160	14	8.10	22	6	3.75	57	12	2.90	46	13	2.10	52	15	8.10	3	11	3.75	15	21	3.00	24	20	2.10	32	32
2	180	20	8.10	37	9	3.75	69	17	2.90	64	19	2.10	81	20	7.70	13	18	3.80	18	46	3.00	29	38	2.10	49	53
3	200	26	7.80	43	12	3.80	83	23	3.00	95	25	2.10	100	26	7.20	19	27	3.85	51	56	3.00	50	61	2.15	67	73
4	212	32	8.05	47	16	3.90	95	33	3.00	100	27	2.10	100	30	7.60	26	40	3.90	62	70	3.05	68	80	2.15	86	90
	At																									
5	212	15	8.10	50	18	3.90	100	36	3.00	100	31	2.10	100	31	7.50	32	55	4.00	77	94	3.05	99	94	2.15	99	96
6	"	30	7.80	53	19	3.90	100	37	3.05	100	32	2.10	100	33	8.10	33	58	4.00	97	95	3.05	99	95	2.15	99	97
7	"	45	8.80	53	19	3.90	100	38	3.00	100	32	2.15	100	34	8.10		60	4.05	98	96	3.10	99	96	2.15	100	98
8	"	60	8.00	57	20	3.90	100	39	3.05	100	34	2.15	100	35	8.00	36	62	4.05	99	98	3.15	100	98	2.20	100	99
9	"	90	8.20	60	21	3.85	100	40	3.05	100	35	2.10	100	37	8.00	40	65	4.00	99	100	3.20	99	100	2.15	100	100

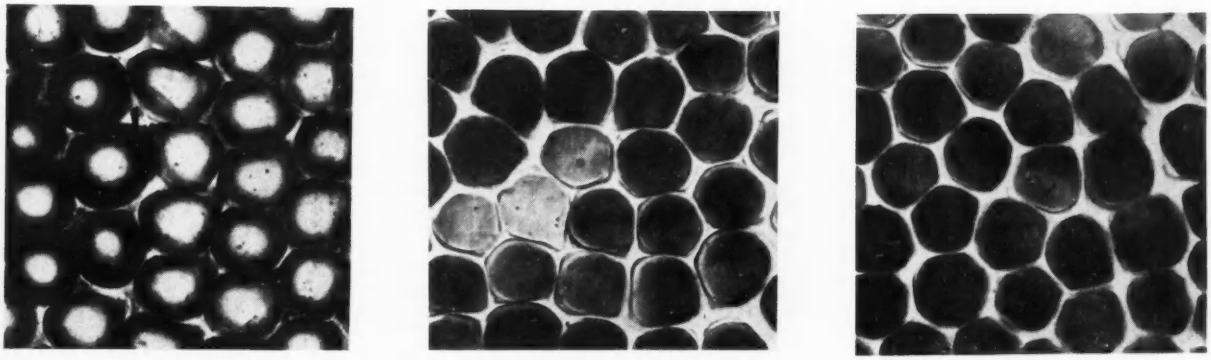
ing, and therefore, no analysis of the data was made.

The color values of the neutral dyeings increased more slowly than those with acid up to 212° F. After 90 minutes run at 212° F. the strength of the ½% dyeings was similar in all cases, while with 2% of dye the no-acid dyeing was 40% weaker than that made with acetic acid.



A B C

Figure 5
A—Calcocid Alizarine Green CGN Ex. (Without Acid) 212° F
B—Calcocid Alizarine Green CGN Ex. (Without Acid) 212° F—30 minutes
C—Calcocid Alizarine Green CGN Ex. (Without Acid) 212° F—30 minutes



A B C

Figure 6
A—Calcocid Alizarine Green CGN Ex. (With Acetic Acid) 212° F
B—Calcocid Alizarine Green CGN Ex. (With Acetic Acid) 212° F—30 minutes
C—Calcocid Alizarine Green CGN Ex. (With Acetic Acid) 212° F—90 minutes

The cross sections of the no-acid samples removed at the boil show slight ring dyeing. After boiling 30 minutes, ring formation was very prominent and after 90 minutes at 212° F. penetration was complete except for a small white area which remained in the center of most fibers. In the case of the dyeings made with acetic acid, the sample removed at the boil was heavily ring-dyed and blue in color. After boiling 30 minutes, the dye had almost completely penetrated the fiber leaving only a small white center. The coloration nearer to the center, however, was much redder than that in the outer region, which remained definitely blue. The dyeing which had boiled 90 minutes exhibited complete penetration but the shade was a reddish blue. The red coloration observed in the cross sections, as well as the shade change of the 2% dye liquors during dyeing, with formic and sulfuric acid, is believed to be due to the well-known instability of this sulfocyanine dye in strong acid solutions. The red color is probably due to a decomposition product. It is, therefore, recommended that this dye be applied in a weak acidic bath, exhausting with acetic acid if necessary.

Calcocid Alizarine Green CGN Ex.

With this dye, the rate of dyeing was accelerated rapidly by the reduction of pH. This is true for both the ½% and 2% dyeings, as indicated by the data in Table VII. While the ½% dyeing without acid was only 60% exhausted after 90 minutes at 212° F., the dye bath containing sulfuric acid was completely exhausted even before the boil was reached.

The reflectance data confirm the accelerated dyeing rate and increased exhaustion in the presence of acid. These results indicate that this dye should be applied by starting neutral and exhausting with acetic acid.

In cross section the no-acid dyeing removed at 212° F. exhibits light ring dyeing. After 30 minutes at 212° F., the fibers are almost completely dyed, and after a further 60 minutes penetration is complete although the fibers remain lightly colored. With all three acids, the penetration is similar except that the color intensity with acetic acid is somewhat less. Figs. 5A B and C shows the cross sections of dyeings made without acid, Fig. 6A B and C shows the cross sections of the dyeings with acetic acid. The first dyeings removed at 212° F. exhibit ring-dyeing while those boiled 30 and 90 minutes are completely dyed.

Metallized Dyes

Calcofast Wool Yellow N, Orange RN, Bordeaux RB Conc., and Green 3B ex-

TABLE VIII

Calcofast Wool Yellow N

Exp. No.	Time °F.	Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	14	7.30	0	0	3.50	7	1	2.85	2	2	1.90	0	2		0	0	3.60	0	2	3.10	0	4	2.0	0	4
2	180	20	7.30	0	0	3.50	9	2	2.90	4	3	1.85	2	3		0	0	3.65	0	4	3.10	0	8	2.0	2	7
3	200	26	7.35	0	0	3.50	10	5	2.90	5	6	1.85	2	4		0	0	3.70	2	10	3.10	2	15	2.05	20	13
4	212	32	7.40	0	0	3.55	20	10	2.90	18	12	1.85	7	6		0	0	3.70	12	18	3.10	10	29	2.10	41	18
	At																									
5	212	15	7.40	0	1	3.60	38	16	2.90	45	20	1.85	8	10		0	1	3.70	22	32	3.10	32	52	2.10	57	28
6	"	30	7.50	0	2	—	—	22	2.95	60	27	1.85	15	14		0	2			38	3.15	41	58		—	35
7	"	45	7.55	0	2	3.60	65	26	2.95	70	30	1.90	22	15		0	3	3.70	41	48	3.15	50	68	2.15	59	43
8	"	60	7.55	0	2.5	3.70	72	28	3.05	76	32	1.85	28	17		0	4	3.70	44	57	3.15	52	70		—	50
9	"	90	7.50	0	3	3.70	79	29	3.10	82	35	1.90	35	21		0	5	3.85	49	62	3.15	64	100		—	56

TABLE IX

Calcofast Wool Orange RN

Exp. No.	Time °F.	Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	13	8.45	0	0	3.90	4	4	3.20	8	4	2.00	4	4		8.50	0	0	4.20	0	7	3.35	9	6	2.05	1	10
2	180	19	8.60	0	0	4.05	18	8	3.25	23	9	2.00	4	7		8.65	0	0	4.25	0	15	3.40	22	19	2.05	2	14
3	200	25	8.65	0	2	4.00	44	17	3.25	26	18	1.95	17	13		8.70	0	0	4.25	19	29	3.40	26	30	2.10	13	25
4	212	31	8.75	0	2	4.05	64	21	3.25	62	25	1.95	38	17		8.80	0	0	4.25	31	36	3.45	36	41	2.05	26	40
	At																									
5	212	15	8.80	2	3	4.00	64	22	3.25	72	34	1.95	54	22		8.80	0	2	4.25	43	48	3.45	64	73	2.05	43	52
6	"	30	8.70	3	3	4.10	84	28	3.25	89	36	2.00	71	28		8.80	2	3	4.30	53	60	3.50	77	82	2.05	57	70
7	"	45	8.70	4	4	4.10	88	29	3.25	92	38	2.00	75	30		8.70	3	4	4.35	65	68	3.50	85	86	2.05	60	72
8	"	60	8.75	4	5	4.10	90	30	3.35	94	40	2.00	75	32		8.75	4	5	4.35	71	72	3.55	87	91	2.05	68	88
9	"	90	8.75	7	7	4.30	93	35	3.40	95	41	2.00	79	37		8.75	6	6	4.45	75	78	3.65	90	100	2.00	74	94

TABLE X

Calcofast Wool Bordeaux RB Conc.

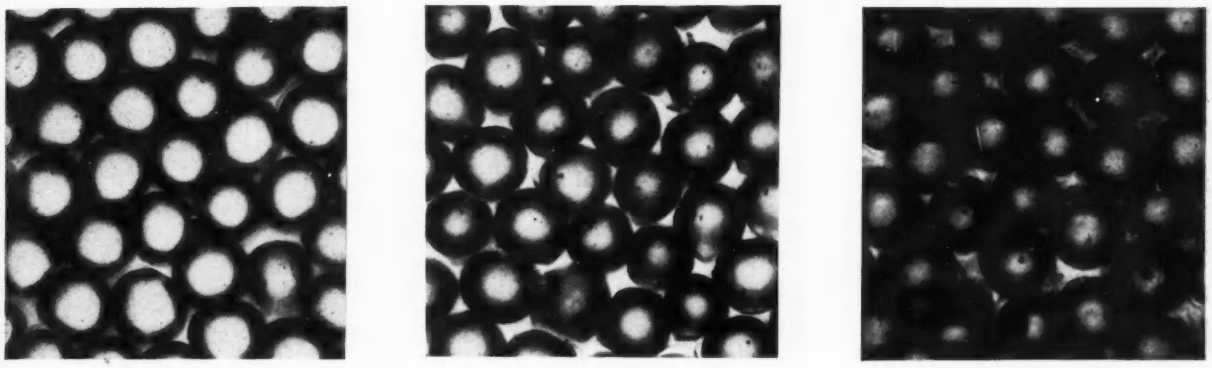
Exp. No.	Time °F.	Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	15	8.20	0	2	4.05	12	6	3.05	8	7	2.20	9	7		8.65	0	2	4.35	3	9	3.30	4	10	2.25	5	10
2	180	21	8.35	0	2	4.10	24	11	3.10	11	11	2.20	18	11		8.65	0	2	4.30	9	16	3.30	7	17	2.30	8	18
3	200	27	8.45	0	2	4.10	40	16	3.10	42	18	2.20	36	17		8.75	0	2	4.35	19	22	3.35	15	31	2.30	15	29
4	212	33	8.50	1	3	4.15	56	20	3.15	71	29	2.20	55	23		8.75	0	3	4.35	20	34	3.35	29	48	2.30	25	44
	At																									
5	212	15	8.50	1	3	4.15	80	27	3.15	92	36	2.20	73	31		8.80	0	4	4.35	32	54	3.35	57	74	2.30	41	68
6	"	30	8.45	8	4	4.15	90	32	3.15	96	40	2.20	82	35		8.75	0	5	4.35	50	65	3.45	71	85	2.30	58	76
7	"	45	8.40	8	5	4.15	94	33	3.20	98	43	2.20	86	37		8.75	0	6	4.35	55	72	3.45	67	92	2.30	63	83
8	"	60	—	—	5	4.15	96	34	3.20	98	44	2.25	88	38		8.70	1	7	4.50	57	76	3.40	82	95	2.30	72	89
9	"	90	8.30	19	8	4.15	98	35	3.35	99	46	2.25	90	43		8.65	12	10	4.50	67	86	3.50	84	100	2.20	78	96

TABLE XI

Calcofast Wool Green 3B

Exp. No.	Time °F.	Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	13	8.00	0	0	3.90	12	5	4.10	9	5	1.85	4	4		5.85	1	3	4.05	0	5	4.20	0	7	2.10	0	6
2	180	20	8.15	0	0	3.90	20	9	4.10	26	9	1.95	14	7		5.60	2	4	4.10	0	10	4.25	4	11	2.15	5	13
3	200	25	8.15	0	0	3.95	28	12	4.10	65	16	2.00	39	12		5.60	5	7	4.10	0	14	4.25	12	21	2.15	11	22
4	212	32	8.10	0	0	4.00	44	15	4.15	70	19	2.00	68	20		5.50	8	9	4.10	10	21	4.25	21	32	2.10	25	38
	At																									
5	212	15	8.25	0	0	3.95	89	22	4.15	97	29	2.00	91	27		5.50	10	12	4.20	20	32	4.25	78	59	2.15	55	62
6	"	30	8.25	0	0	4.00	97	24	4.20	99+	31	2.00	96	30		5.60	18	16	4.20	34	46	4.25	84	74	2.15	68	77
7	"	45	8.20	0	0	4.05	95	28	4.20	99+	33	2.00	97	33		5.65	20	18	4.30	42	52	4.30	88	85	2.15	77	85
8	"	60	8.20	0	0	4.05	97	29	4.20	99+	35	2.00	97	37		5.70	26	20	4.30	47	62	4.35	90	86	2.15	85	86
9	"	90	8.00	8	2	4.05	98	30	4.25	99+	36	2.00	98	38		5.90	26	24	4.30	58	65	4.30	94	100	2.15	88	97

hibited some similarities in their dyeing behavior as shown by cross-section examination and by the data in Tables VIII to XI. With the exception of the 2% Green 3B dyeing, none of these dyes were taken up by nylon from a neutral bath. In general, of the three acids used, formic acid gives the best exhaustion and final color values. Cross sections of the acetic acid dyeings removed at the boil indicated only very slight dyeing while the formic acid and sulfuric acid light ring-dyeing was obtained. The dyeings after 30 minutes at 212° F. were ring-dyed with acetic acid, heavily ring-dyed with formic acid and most heavily ring-dyed with sulfuric acid. After 90 minutes at 212° F., all dyeings remained ring-dyed, with the formic



A B C

Figure 7

A—Calcofast Wool Orange RN (With Acetic Acid) 212° F—90 minutes
B—Calcofast Wool Orange RN (With Formic Acid) 212° F—90 minutes
C—Calcofast Wool Orange RN (With Sulfuric Acid) 212° F—90 minutes

TABLE XII

Calcomine Green BT Conc. C.I.—589

			½% Dye, Dyebath Ratio, 1:30												2% Dye, Dyebath Ratio, 1:30											
			No Acid			2% Acetic			2% Formic			2% Sulfuric			No Acid			2% Acetic			2% Formic			2% Sulfuric		
Exp. No.	Time °F.	Min.	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv
	To																									
1	160	14	8.25	0	4	3.55	16	8	2.65	33	9	1.80	38	10	8.35	2	5	3.70	0	9	2.70	0	11	1.80	4	13
2	180	21	8.30	0	6	3.55	32	16	2.65	45	19	1.75	56	17	8.40	4	8	3.70	0	17	2.75	0	22	1.85	12	24
3	200	27	8.35	8	10	3.60	65	27	2.65	78	29	1.75	73	23	8.40	7	12	3.75	9	36	2.70	14	41	1.85	24	35
4	212	33	8.30	17	14	3.65	77	28	2.65	91	33	1.75	90	39	8.50	15	23	3.80	30	58	2.75	42	69	1.85	44	60
	At																									
5	212	15	8.35	33	19	3.65	91	33	2.70	96	37	1.75	98	47	8.50	21	38	3.80	61	83	2.70	74	90	1.85	48	78
6	"	30	8.35	58	26	3.65	93	36	2.70	97	37	1.75	—	48	8.50	30	49	3.80	70	84	2.70	77	92	1.85	80	90
7	"	45	8.30	58	27	3.70	96	37	2.70	98	38	1.75	99	43	8.50	36	57	3.80	74	85	2.75	83	94	1.85	86	92
8	"	60	8.30	63	28	3.65	96	37	2.75	98	39	1.80	99+	39	8.50	38	58	3.80	80	92	2.75	84	97	1.85	91	95
9	"	90	8.25	71	30	3.75	97	38	2.75	99	40	1.80	99+	40	8.50	46	65	3.90	82	93	2.75	88	100	1.90	84	98

and sulfuric acid dyeings much heavier than that with acetic acid. Fig. 7A, B and C shows cross sections of the nylon dyed with Calcofast Wool Orange RN using acetic, formic and sulfuric acids, after 90 minutes at 212° F.

Calcofast Wool Green 3B

In contrast to the other three dyes, Green 3B dyed nylon lightly at the 2% concentration without acid. This can be accounted for, however, by the lower pH of aqueous solutions of this dye (pH 5.85). No dyeing is observed in the ½% no-acid bath because in more dilute solutions the pH is higher (8.00). With the exception of the 2% dyeing with acetic acid, all of the acid baths were well exhausted.

Calcofast Wool Orange RN

Both the ½% and 2% dyeings of this dye show that sulfuric acid does not give as good exhaustion or color value as formic acid. The acetic acid dyeings were poorest in color value even though exhaustion was equal to or better than that of the sulfuric acid dyeings. The best dyeings were obtained with formic acid, which showed gradual exhaustion and increase in color value throughout the dyeing period.

Calcofast Wool Yellow N

The dyeings with sulfuric acid were much lower in color value than those made with formic acid. This is due principally to the lower exhaustion of dye from the sulfuric acid dye bath, particularly at the ½% concentration of dye. Data on the formic acid dyeings indicate that long periods of dyeing or higher formic acid concentrations are required for best utilization of this dye.

Calcofast Wool Bordeaux RB Conc.

The reflectance and exhaustion data for this dye are consistent with each other indicating that during the dyeing operation the color value increases progressively with exhaustion.

To a small degree the sulfuric acid dyeings are less exhausted than those with formic acid, while the color values are only slightly lower.

Direct Dyes

Calcomine Green BT Conc.

Without acid this dye shows little exhaustion below 212°F., but from this point the exhaustion is gradual, reaching 71% for the ½% dyeing and 46% for the 2% dyeing after 90 minutes at 212° F. The presence of acid increases the rate of exhaustion of the dye bath, the lower the pH, the greater the exhaustion in general at a given time. (Table XII).

Cross sections show that the no-acid dyeings removed at 212° F. are very lightly ring-dyed. After 30 minutes and 90 minutes at 212° F. the rings become progressively heavier but a larger undyed center remains even in the latter case. The acid dyeings are similar to those without acid except for differences in color intensity.

Calcomine Sky Blue FF Ex. Conc.

In general, little or no exhaustion of this dye is observed in the absence of acid or at temperatures below 200° F. Formic or sulfuric acid and near-boiling tempera-

TABLE XIII

Calcomine Sky Blue FF Ex. Conc. C.I.—518

Dyebath Ratio, 1:30

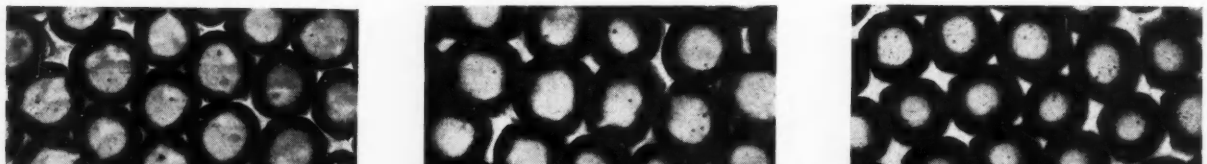
Exp. No.	Time °F.	Time Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	14	8.10	0	0	3.70	0	2	2.75	4	3	1.70	23	6	8.00	0	0	3.75	0	2	2.80	0	3	1.75	4	8
2	180	20	8.20	0	0	3.70	0	3	2.70	7	4	1.70	40	12	8.15	0	0	3.75	3	5	2.85	3	4	1.75	6	16
3	200	26	8.25	0	0	3.70	4	7	2.70	30	11	1.70	70	22	8.25	0	0	3.80	6	10	2.85	6	11	1.75	21	29
4	212	32	8.30	0	0	3.70	26	16	2.80	54	19	1.70	93	27	8.30	0	0	3.80	10	16	2.85	12	19	1.75	29	49
	At																									
5	212	15	8.35	0	0	3.75	74	31	2.80	99	30	1.70	97	29	8.30	0	0	3.80	20	31	2.85	80	55	1.75	77	85
6	"	30	8.30	0	0	3.75	89	23	2.80	99+	31	1.70	99+	30	8.35	0	0	3.85	38	50	2.85	95	68	1.80	95	96
7	"	45	8.30	0	0	3.75	90	27	2.85	99+	32	1.70	99+	31	8.30	0	2	3.85	47	67	2.85	95	72	1.70	99	97
8	"	60	8.30	0	1	3.80	93	41	2.80	99+	35	1.70	99+	32	8.10	0	3	3.85	65	74	2.85	96	74	1.70	99	99
9	"	90	8.25	0	2	3.80	94	43	2.85	99+	36	1.75	99+	33	8.10	0	4	3.90	69	75	2.85	98	92	1.70	100	100

TABLE XIV

Calcodur Yellow RL C.I.—349—A

Dyebath Ratio, 1:30

Exp. No.	Time °F.	Time Min.	½% Dye: No Acid pH	%E	%Cv	½% Dye: 2% Acetic pH	%E	%Cv	½% Dye: 2% Formic pH	%E	%Cv	½% Dye: 2% Sulfuric pH	%E	%Cv	2% Dye: No Acid pH	%E	%Cv	2% Dye: 2% Acetic pH	%E	%Cv	2% Dye: 2% Formic pH	%E	%Cv	2% Dye: 2% Sulfuric pH	%E	%Cv
	To																									
1	160	14	7.60	0	0	3.75	4	1	3.00	6	3	1.85	14	8	7.55	0	0	3.85	17	2	3.05	0	3	1.85	2	9
2	180	20	7.65	0	0	3.75	4	2	3.00	9	4	1.85	36	17	7.55	0	0	3.90	17	3	3.05	0	5	1.85	11	20
3	200	26	7.60	0	0	3.85	4	6	3.00	22	11	1.85	68	30	7.70	0	0	3.95	25	7	3.10	5	14	1.85	15	35
4	212	32	7.80	0	0	3.85	28	12	3.05	42	19	1.85	99+	40	7.75	0	0	3.95	—	17	3.10	5	24	1.85	32	54
	At																									
5	212	15	7.80	0	0	3.95	65	39	3.05	99+	48	1.85	99+	42	7.80	0	1	4.00	33	52	3.20	31	53	1.85	56	78
6	"	30	7.80	0	0	4.00	99+	46	3.10	99+	52	1.85	99+	45	7.80	0	2	4.10	48	69	3.20	52	78	1.85	72	88
7	"	45	7.80	0	0	4.05	99+	52	3.10	99+	53	1.85	99+	46	7.75	0	2	4.10	57	80	3.20	64	91	1.85	89	95
8	"	60	7.75	0	0	4.00	99+	53	3.10	99+	54	1.85	99+	48	7.70	0	2	—	—	91	3.20	81	92	1.95	92	98
9	"	90	7.75	0	1	4.05	99+	54	3.15	99+	55	1.85	99+	49	7.60	0	5	4.10	73	92	3.20	84	97	1.85	97	100



A B C

Figure 8

A—Calcomine Sky Blue FF Ex. Conc. (With Acetic Acid) 212° F—90 minutes
B—Calcomine Sky Blue FF Ex. Conc. (With Formic Acid) 212° F—90 minutes
C—Calcomine Sky Blue FF Ex. Conc. (With Sulfuric Acid) 212° F—90 minutes

tures are necessary with the 2% dyeings in order to obtain exhaustion within a reasonable period of time. However, in the case of the ½% dyeings these acids exhaust the dye too rapidly, and therefore acetic acid is indicated for the application of this dye in light shades. The reflectance data shown in Table XIII are in agreement with these observations. Acetic acid results in the greatest color value for the ½% dyeings whereas formic or sulfuric acid is indicated for heavy shades.

The cross sections of all dyeings with acid were similar except for an increase in color intensity with increase in acidity. All of the dyeings exhibited ring-dyeing and increasing penetration of the dye with increase in time and temperature. All the final dyeings with acid, however, exhibited undyed central regions, as can be seen from Fig. 8A B and C, which are cross sections of the nylon after 90 minutes at 212° F. dyed with acetic, formic or sulfuric acid.

Calcodur Yellow RL

This dye does not exhaust from a neutral dye bath regardless of temperature and shows poor exhaustion at temperatures below 212° F. with either acetic or formic acids. Sulfuric acid exhausts the ½% dye bath rapidly with increasing temperature, but produces only a more gradual exhaustion of the 2% dye bath.

The reflectance data shown in Table XIV indicates the more rapid color development of this dye with sulfuric acid, and indicates the need for the use of the correct acid and for extended time at 212° F.

When examined in cross section, all of the acid dyeings removed on reaching

TABLE XV

Calcodur Pink 2BL C.I.—353

Exp. No.	Time °F.	Time Min.	½% Dye, Dyebath Ratio, 1:30: No Acid pH	No Acid %E	No Acid %Cv	2% Acetic pH	2% Acetic %E	2% Acetic %Cv	2% Formic pH	2% Formic %E	2% Formic %Cv	2% Sulfuric pH	2% Sulfuric %E	2% Sulfuric %Cv	2% Dye, Dyebath Ratio, 1:30: No Acid pH	No Acid %E	No Acid %Cv	2% Acetic pH	2% Acetic %E	2% Acetic %Cv	2% Formic pH	2% Formic %E	2% Formic %Cv	2% Sulfuric pH	2% Sulfuric %E	2% Sulfuric %Cv
	To																									
1	160	16	7.60	0	0	4.15	0	2	2.90	4	2	1.90	8	2	7.50	0	0	4.20	0	2	2.95	0	2	1.90	1	4
2	180	22	7.70	0	0	4.15	0	3	2.95	9	4	1.90	15	7	7.60	0	0	4.20	0	3	3.00	0	4	1.90	1	8
3	200	28	7.75	0	0	4.15	4	6	2.95	18	8	1.90	39	13	7.65	0	0	4.20	0	6	3.00	3	7	1.90	7	14
4	212	34	7.75	0	0	4.15	40	10	3.00	31	14	1.90	54	18	7.70	0	0	4.20	3	12	3.00	10	16	1.90	20	22
	At																									
5	212	15	7.75	0	0	4.20	68	24	3.00	89	36	1.90	93	29	7.65	0	0	4.30	2	30	3.05	23	40	1.90	31	40
6	"	30	7.75	0	0	4.30	76	41	3.05	99+	37	1.90	99+	30	7.65	0	0	4.30	43	57	3.05	46	56	1.90	68	67
7	"	45	7.70	0	0	4.35	99+	42	3.05	99+	38	1.90	99+	33	7.65	0	0	4.30	57	67	3.05	61	75	1.90	79	70
8	"	60	7.60	0	0	4.35	99+	49	3.05	99+	42	1.85	99+	36	7.60	0	1	4.30	68	74	3.15	75	87	1.90	90	74
9	"	90	7.60	9	1	4.35	99+	50	3.05	99+	50	1.90	99+	37	7.50	0	1	4.30	84	85	3.15	89	100	1.90	97	90

TABLE XVI

Calcochrome Black T Ex. Conc. C.I.—203

Exp. No.	Time °F.	Time Min.	½% Dye, Dyebath Ratio, 1:30: No Acid pH	No Acid %E	No Acid %Cv	2% Acetic pH	2% Acetic %E	2% Acetic %Cv	2% Formic pH	2% Formic %E	2% Formic %Cv	2% Sulfuric pH	2% Sulfuric %E	2% Sulfuric %Cv	2% Dye, Dyebath Ratio, 1:30: No Acid pH	No Acid %E	No Acid %Cv	2% Acetic pH	2% Acetic %E	2% Acetic %Cv	2% Formic pH	2% Formic %E	2% Formic %Cv	2% Sulfuric pH	2% Sulfuric %E	2% Sulfuric %Cv
	To																									
1	160	15	7.00	4	23	4.00	59	42	3.30	75	53	2	75	55	6.80	7	26	3.95	14	28	3.25	33	40	2.25	25	42
2	180	21	7.00	15	31	4.00	90	69	3.30	88	70	—	97	64	6.90	11	37	3.95	35	57	3.35	62	71	2.25	63	71
3	200	27	7.10	29	52	4.00	95	73	3.30	90	75	2	99+	77	6.90	19	66	4.00	69	90	3.40	86	84	2.20	78	84
4	212	33	7.20	40	66	4.05	97	84	3.35	96	86	2	99+	78	7.00	25	85	4.10	86	96	3.35	92	92	2.25	90	90
	At																									
5	212	15	7.20	50	76	4.05	99	86	3.35	99+	95	2	99+	91	7.10	67	91	4.10	—	97	3.35	99	96	2.25	99	95
6	"	30	7.15	61	80	4.05	99+	86	3.35	99+	96	2	99+	92	7.15	70	92	4.10	90	98	3.40	99+	97	2.25	100	96
7	"	45	7.05	64	90	4.00	99+	88	3.40	99+	97	2	99+	93	7.20	72	96	4.10	92	99	3.35	99+	98	2.25	99+	97
8	"	60	7.10	68	92	4.00	99+	96	3.40	99+	98	2	99+	99	7.25	76	98	4.10	94	100	3.45	99+	99	2.25	99+	98
9	"	90	7.15	75	100	4.05	99+	100	—	99+	100	2	99+	100	7.15	80	100	4.10	97	100	3.40	99+	100	2.25	99+	100

Since this is an indicator dye which changes shade as the pH varies, the reflectance values of the dyeings by the various methods can only be compared within that series.

212° F. were ring-dyed, the acetic acid dyeings being the lightest. After boiling 30 minutes, the fibers remained ring-dyed but were heavier in shade. After boiling for 90 minutes, penetration was complete in the fibers dyed with any of the three acids.

Calcodur Pink 2 BL

This dye shows little or no exhaustion in the absence of acid or at temperatures under 200° F. (See Table XV). At 212° F., however, exhaustion proceeds rapidly to completion in the acidified ½% dye bath, and less rapidly in the 2% dye bath. The rate of exhaustion is greater at lower values of pH.

Reflectance measurements of the 2% dyeings show that formic acid gives the best color value even though the exhaustion is slightly less than that with sulfuric acid.

Cross sections of fibers from all dyeings removed at 212° F. exhibit light ring-deying, which increases in color intensity during continued boiling. Dyeings removed after 90 minutes at 212° F. reveal that fibers from the acetic and formic acid baths are penetrated to the center, but show heavier coloration in the outer portion of the fiber. The sulfuric acid dyeing exhibits the same heavy ring formation but the center of the fiber undyed.

Calcochrome Dyes

These dyes were studied in two phases since the dyeing and the chromation of the dyes are independent phenomena. To carry out this work, the dyeing study was conducted in the same manner as with the other dyes. A sufficient number of dyeings were made using 2% of dye and 2% sulfuric acid to carry out the chroming study in the same manner and under the same time-temperature and acid conditions as the dyeing study. The chromation bath was made up with one percent of sodium bichromate. In certain cases, some bleeding of dye was noted from the nylon into the chroming bath, depending on the nature of the dye and the pH of the bath. The pH ranges of the chroming baths were as follows:

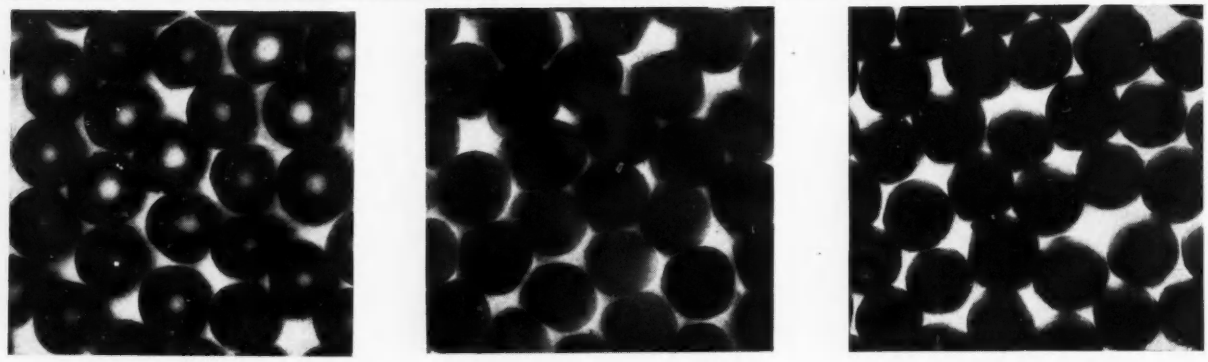
Acid	*pH*
None	6.0—6.3
2% Acetic Acid	3.8—4.2
2% Formic Acid	3.1—3.4
2% Sulfuric Acid	2.1—2.4

The Dyeing of Calcochrome Black T Ex. Conc.

This dye appears to exhaust from the dye bath without acid, (see Table XVI) starting somewhat below 160° F. and continuing at a moderate rate with rising temperature and throughout the dyeing period. The presence of acid greatly accelerates the exhaustion, which is complete by the time 212° F. is reached in the ½% dyeings, and practically so in the 2% dyeings. The development of the shade, however, continued during the entire period at 212°F. Since this dye is used for blacks on nylon in percentages of 5 to 8% and the rate of exhaustion decreases with increasing concentration, either formic or sulfuric acid preferably formic may be used with these percentages. Little color value is obtained in the no-acid dyeings, and cross-sectional studies reveal very little coloration within the fiber, despite the apparent exhaustion. Both effects are due to decomposition of the dye under that dyeing condition. With acid in the bath, however, the penetration of the dye at 212° F. leaves only the center of the fibers undyed. After 30 minutes at 212° F., the fibers are completely penetrated and uniform in shade. Fig. 9A, B and C show the cross sections of the dyeings, dyed with acetic acid at 212° F., and after 30 and 90 minutes at 212° F.

The Chromation of Calcochrome Black T Conc.

In chroming without acid, some of the



A B C

Figure 9

A—Calcochrome Black T Ex. Conc. (With Acetic Acid) 212° F
B—Calcochrome Black T Ex. Conc. (With Acetic Acid) 212° F—30 minutes
C—Calcochrome Black T Ex. Conc. (With Acetic Acid) 212° F—90 minutes

TABLE XVII

Calcochrome Violet B C.I.—169

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv	2% Dye, Dyebath Ratio, 1:30 — No Acid pH	%E	%Cv	2% Acetic pH	%E	%Cv	2% Formic pH	%E	%Cv	2% Sulfuric pH	%E	%Cv
	To																									
1	160	15	8.05	—	3	3.95	89	37	3.10	91	36	2.15	96	37	7.65	5	11	4.35	29	52	3.15	34	57	2.20	46	69
2	180	21	8.15	—	3	3.95	91	45	3.15	99	42	2.15	98	43	7.75	5	18	4.25	52	88	3.20	76	90	2.20	74	93
3	200	27	8.25	—	7	4.00	99+	52	3.15	99+	51	2.15	99+	50	7.90	10	30	4.20	85	93	3.20	95	95	2.20	96	94
4	212	33	8.30	—	7	4.00	99+	52	3.15	99+	51	2.15	99+	51	8.00	13	39	4.20	92	95	3.20	97	96	2.20	97	95
	At																									
5	212	15	8.30	—	8	4.10	99+	53	3.25	99+	52	2.15	99+	51	8.05	18	40	4.15	94	96	3.25	97	97	2.25	97	96
6	"	30	8.35	—	8	4.05	99+	53	3.20	99+	52	2.15	99+	52	8.05	18	41	4.10	93	97	3.30	97	98	2.25	97	97
7	"	45	8.30	—	9	4.05	99+	54	3.25	99+	53	2.15	99+	52	8.00	18	42	4.10	94	98	3.30	97	98	2.25	97	98
8	"	60	8.30	—	10	4.10	99+	55	3.20	99+	54	2.15	99+	53	8.00	19	43	4.00	92	99	3.35	97	99	—	97	99
9	"	90	8.30	—	11	4.10	99+	56	3.20	99+	55	2.20	99+	57	8.00	23	44	3.80	91	100	3.30	97	100	2.25	98	100

dye was removed from the nylon and chromed in the bath, the amount removed increasing with time and temperature. In the presence of acid no bleeding occurred, and the acidified chroming baths remained yellow without significant shade differences between them.

The determination of color value of the chromed dyeings was complicated by the changes in shade due to chromation. However, both the dyeings and cross sections of samples chromed without acid were much redder in shade than those made with acid. All three acids gave a blue shade indicative of more complete chromation, but the sulfuric and formic acid chromations were weaker in color value possibly due to decomposition of the dye at the lower pH due to oxidation.

Chromation without acid in the bath is incomplete even after 90 minutes at 212° F. With acid in the bath, chromation takes place rapidly so that when 212° F. is reached, although the acetic acid dyeings show both unchromed and chromed fibers the formic and sulfuric acid dyeings are completely chromed. After 30 minutes at 212° F. the acetic acid dyeing also appears to be completely chromed, whereas the formic and sulfuric acid samples have reached and passed their maximum chromation and have become weaker in shade.

The Dyeing of Calcochrome Violet B

Without acid this dye exhausts slowly and poorly, reaching exhaustion of only 23% after 90 minutes at 212° F. in the 2% dyeing. No exhaust is indicated for the ½% dyeing. The presence of acetic, formic, or sulfuric acid produces extremely rapid exhaustion. As shown in Table XVII complete exhaustion is obtained well below 212° F. in the ½% dyeings, while the 2% dyeings are practically exhausted by the time 212° F. is reached. At 212° F., no further exhaustion takes place and complete exhaustion in the 2% dyeings is not obtained, despite the rapid rate of exhaustion at temperatures below the boil.

The reflectance data for the ½% dyeings with acid shows that the color value of the dyed nylon increases considerably during the dyeing period after complete exhaustion of the dye bath. This indicates that exhaustion takes place too rapidly to permit adequate diffusion of the dye into the fiber during exhaustion. The final color value reached as a result of continued diffusion is in agreement with the exhaustion values obtained.

The Chromation of Calcochrome Violet B

In the chromium bath containing no acid, some of this dye bleeds rapidly out of the nylon fiber, and is chromed in solution. This is indicated by the progressive increase in the intensity of blueness in the bath. At the same time, of course, chromation is taking place on the fiber.

While acid in the chroming bath has little effect in preventing bleeding, chromation takes place more rapidly in the presence of formic acid or sulfuric acid. The use of acetic acid in chromation, however, produces a deeper shade. This indicates that at this percentage of dye, the pH obtained with 2% formic or sulfuric acid is too low for best color value.

The shade exhibited by the fabric and fiber cross sections shows that chromation without acid or with acetic and formic acids is incomplete at the time 212° F. is reached, but is complete in the case of sulfuric acid. Chromation with formic acid appears to be complete after 30 minutes at 212° F. while with acetic acid the shade is still changing, after 90 minutes at 212° F.

TABLE XVIII

Calcochrome Green S.W.

Exp. No.	Time °F.	Min.	½% Dye, Dyebath Ratio, 1:30 — No Acid			2% Acetic			2% Formic			2% Sulfuric			2% Dye — No Acid			2% Acetic			2% Formic			2% Sulfuric		
			pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv	pH	%E	%Cv
	To																								
1	160	13	7.80	0	0	3.90	4	2	3.10	4	4	2.10	0	10	8.05	0	0	3.95	10	3	3.10	0	7	2.15	10	12
2	180	19	8.10	0	0	3.90	17	10	3.10	29	16	2.15	15	26	8.20	0	0	4.00	0	13	3.15	19	19	2.15	21	34
3	200	25	8.20	0	0	4.00	58	34	3.10	79	42	2.10	77	49	8.25	0	0	4.05	12	49	3.15	41	56	2.15	40	75
4	212	31	—	—	0	4.00	99+	57	3.10	99+	58	2.10	99+	55	—	—	0	4.10	37	85	3.20	58	86	2.15	60	94
	At																									
5	212	15	8.35	0	0	4.00	99+	62	3.10	99+	59	2.10	99+	58	8.45	0	0	4.20	51	87	3.20	60	91	2.15	73	95
6	"	30	8.35	0	0	4.05	99+	63	3.10	99+	60	2.10	99+	59	8.35	0	0	4.20	51	90	3.25	59	92	2.15	75	97
7	"	45	8.35	0	0	4.05	99+	64	3.10	99+	63	2.10	99+	60	8.30	0	0	4.15	54	91	3.20	60	93	2.15	75	98
8	"	60	8.30	0	0	4.10	99+	65	3.10	99+	64	2.15	99+	61	8.30	0	0	4.20	54	92	3.25	60	94	2.15	75	99
9	"	90	8.30	0	0	4.10	99+	70	3.10	99+	67	2.15	99+	62	8.30	0	1	4.20	54	93	3.25	60	95	2.15	75	100

The Dyeing of Calcochrome Green SW

This dye shows no exhaustion whatsoever without acid in the dye bath. (See Table XVIII). In the presence of 2% of any of the three acids and at a temperature of 180° F. or higher, the dyeing rates of the ½% dyeings are so rapid that no dye is left in the bath when 212° F. is reached. The 2% dye baths exhibit the same requirement of temperature and acid conditions for rapid exhaustion, and are all close to maximum exhaustion after 15 minutes at 212°. However, the final exhaustions are far from complete, as only 54%, 60% and 75% of the dye was exhausted from the acetic, formic and sulfuric acid dye baths respectively.

Reflectance data confirm the effects of temperature and acid indicated by the exhaustion data. It was also found that despite the large variations in final exhaustion values of the 2% dye baths, the final reflectance values are close.

Cross sections show that in the acetic and formic acid dyeings the fibers are ring-dyed at 212° F. but completely penetrated after 30 minutes at 212° F. In fibers of the sulfuric acid dyeings removed at 212° F., however, penetration is practically complete.

The Chromation of Calcochrome Green SW

Although this dye bleeds from the nylon into the chroming bath, the amount of dye so removed is much reduced as the pH is lowered. In the absence of acid the degree of chromation reached after 90 minutes at 212° F. is insufficient to bring the dyed blue shade out of the blue cast into the green. The use of this change in shade for estimating the progress of chromation showed that this point was reached at 200° F. in the presence of sulfuric acid and after somewhat more than 15 minutes at 212° F. in the bath containing formic acid. With acetic acid 90 minutes at 212° F. was required to reach approximately the same degree of chromation. The final shade of the dyeing chromed with sulfuric acid is yellower and duller than the bright bottle green obtained with formic acid chromation.

All cross sections of the nylon made at the different stages of chromation without acid exhibited the blue color of the unchromed dye. From the chromation with acetic acid only the dyeing which was chromed for 90 minutes at 212° F. was green. In the formic acid chromation, uniformly green cross sections were obtained from the nplon removed after 30 minutes at 212° F. However, those removed after 90 minutes are more definitely green, indicating the continued chromation and color development at the boil. The sulfuric acid chromation resulted in uniformly penetrated green cross sections at 212° F., and showed little change in longer boiling periods.

Discussion on the Influence of Acids

Our experiments show that the effect of acids in the application of acetate dyes to nylon is slight and that the penetration of the dye into the individual fibers is in general quite rapid and uniform. These dyes give good levelness and color value, regardless of the method of application. Acetate dyes, however, while possessing excellent dyeing properties, do not exhibit good fastness to wet processing.

The acid dyes show considerable diversity in their dyeing properties over the range of pH studied. The dyeing rate of a number of these dyes is greatly accelerated by lowering the pH and raising the temperature. Some show a low exhaustion equilibrium value regardless of pH while others exhibit a marked increase in exhaustion with lowering of pH. Acid dyes are used in practice because they generally have good wet fastness properties and selected members of the group also have excellent fastness to light. However, acid dyes applied to nylon tend to accentuate not only differences which exist in the original fibers but also variations introduced by treatments prior to dyeing. Examples of these effects are found in warp streaks, barre marks, selvedge effects, etc.

Metallized dyes may be satisfactorily applied to nylon at a high temperature and with sufficiently low pH. Formic acid appears to give the best color value with these dyes. In general, sulfuric acid appears to retard exhaustion, some dyes being affected to a large extent. Higher percentages of formic acid and longer periods of dyeing are indicated for these dyes.

Direct dyes are affected in their dyeing rates by changes in pH in the same manner as the acid dyes. With some of these dyes the diffusion of the dye into the fibers is comparatively slow and does not reach completion in a normal period of dyeing. Some members of the group are superior to acid dyes in fastness to perspiration or light.

Chrome dyes when applied in the same manner as acid dyes, exhibit similar dyeing characteristics. Although the chromation of dyes on nylon have been reported to present difficulties, our experiments have shown that lowering the pH of the chrome bath markedly increases the rate and extent of chromation. Experiments also indicate that the addition of more chrome often has little or no effect. Chrome dyes offer the advantages of high tinctorial value and good wet fastness properties.

Influence of Acidity on Tensile Characteristics

General remarks made from time to time in the literature would indicate that nylon should not be dyed in mineral acid solutions of low pH because of consequent loss in tensile strength. Carlene, Fern, and Vickerstaff *(8)* have shown that the treatment of nylon in acid solutions at pH1 causes about 12% loss in tensile strength, while the same treatment in the presence of dye may result in loss up to 50% in tensile strength, depending upon

TABLE XIX

Treatment*	Tensile Strength		After 12 Months	
	Filling	Warp	Filling	Warp
Water only	82 lb.	83 lb.	76.1 lb.	81.1 lb.
5% sulfuric acid	79 lb.	75 lb.	76.6 lb.	76.0 lb.
10% sulfuric acid	80 lb.	80 lb.	73.0 lb.	76.8 lb.
5% formic acid	86 lb.	84 lb.	79.5 lb.	79.1 lb.
10% formic acid	84 lb.	84 lb.	81.6 lb.	79.6 lb.
15% formic acid	84 lb.	85 lb.	78.1 lb.	79.5 lb.
25% formic acid	80 lb.	82 lb.	77.0 lb.	77.3 lb.

* All percentages of acid based on the weight of nylon.

the concentration of dye. Dyeings in formic acid showed no loss in tensile strength. Peters *(5)* states that "nylon yarn which has been treated under drastic dyeing conditions, viz. for 3 to 4 days at 60° C. in 500 vol. at pH 1.16 gave the same titre as untreated nylon. Hence no hydrolysis occurs during dyeing at 160° F." Loasby *(9)* reports 5% degradation in N sulfuric acid at 90° C. in 16 minutes and 25% in 6 hours.

Our tensile data on dyed and undyed skeins, fabric and single fibers indicate that the acid dyeing methods used in the time-temperature studies, the lowest pH being 2, are not severe enough to affect the tensile properties of nylon. Table XIX shows the tensile strength data obtained with 1-inch strips of nylon parachute cloth treated with water and various acid solutions in a 20 to 1 bath for 1 hour at 200° F., but in the absence of dye. These data do not reveal significant differences in tensile strength due to the various treatments, and the conclusion is drawn that the presence of acid in the dyeing conditions used in these experiments has little effect upon the tensile strength of the nylon.

In order to show whether dye concentrations normally used in practice would affect the tensile strength under acid dyeing conditions, dyeings were made with and without 2% Calcodur Pink 2 BL on 5-gram skeins of nylon in a 50:1 bath at 190° F. for 1 hour. Table XX shows the tensile strength and elongations at break obtained with this nylon before and after dyeing.

These results indicate that in the application of dye over a practical range of pH the tensile strength of nylon is not greatly decreased.

TABLE XX

Treatment*	Tensile Strength in Pounds	% Elongation
None	3.52±0.05	19.2±0.9
Distilled water only	3.40±0.13	24.8±1.4
5% acetic acid	3.51±0.04	25.7±0.7
5% acetic acid + 2% Calcodur Pink 2 BL	3.44±0.10	24.9±1.6
5% sulfuric acid	3.38±0.12	23.4±1.5
5% sulfuric acid + 2% Calcodur Pink 2 BL	3.38±0.07	24.7±1.2
10% sulfuric acid	3.34±0.14	23.8±1.1
10% sulfuric acid + 2% Calcodur Pink 2 BL	3.19±0.14	23.4±1.0

*Percentages of dye and acid are based on the weight of nylon.

Additional information on the effect of acids on the tensile characteristics of nylon was obtained from single filament stress-strain measurements. The single filaments were removed from nylon pieces like those used in the dyeing study. After mounting on glass hooks, each filament was wet out and calibrated in water on a fiber balance similar to those described by Sookne and Rutherford *(10)*, except that the recording was not automatic. A fiber was said to be calibrated when its stress-strain curve up to 11% extension was found to be reproducible on repeated extensions after periods of rest in water of at least 24 hours. The calibrated fibers were then given various treatments and again extended on the fiber balance. Any effect of the treatment upon the physical properties of the nylon fiber would result in a deviation from the original curve obtained. In the absence of such a deviation, it was assumed that the nylon had not been changed by the treatment. Table XXI shows stress-strain data on duplicate single fibers for the following treatments:

A—Dyeing in 400 ml. of sulfuric acid solution at pH 1 containing 0.060 g. Calcocid Alizarine Blue SAPG (C. I. 1054) and 0.020 g. Calcocid Fast Red A (C. I. 176), no other fiber being in the bath.

B—Treatment at pH 1 in sulfuric acid solution without dye. These treatments were carried out by heating to boiling in 30 minutes and boiling for 1½ hours.

After treatment, the fibers were rinsed thoroughly in water and were then extended in water as before treatment. Of the extensions listed in the table, number 4 is the final calibration extension, number 5 is the first extension after treatment and number 7 is the third extension after treatment. The column stating initial length affords a measure of any change

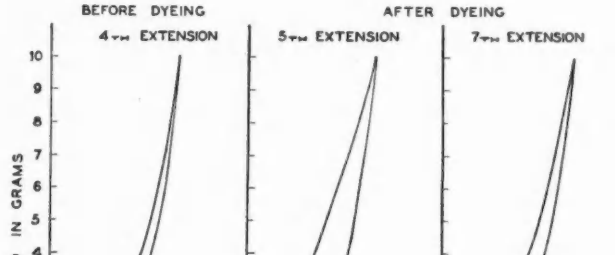


Figure 10

TABLE XXI

Fiber No.	Treatment	Extension No.	Fiber Length Under Zero Load —mm.—	Load at 6% Extension	Load at 11% Extension
18	Dyed with Blue SAPG and Fast Red A in pH 1 H_2SO_4	4	59.3	2.95 g.	9.30 g.
		5	58.1	3.14	7.50
		7	59.1	2.86	8.60
19	Dyed with Blue SAPG and Fast Red A in pH 1 H_2SO_4	4	59.9	3.05	9.68
		5	58.8	3.18	8.04
		7	59.6	2.96	8.60
20	Control, treated in pH 1 H_2SO_4	4	52.5	2.72	8.92
		5	51.4	2.80	7.82
		7	52.2	2.70	8.12
21	Control, treated in pH 1 H_2SO_4	4	55.6	2.72	8.70
		5	54.2	2.80	6.15
		7	55.5	2.65	7.80
22	Treated and extended in pH 1 H_2SO_4	4	54.4	2.55	8.28
		5	52.8	2.60	5.94
		7	54.0	2.45	7.45

in fiber length following treatment. Figure 10 shows the successive extension relaxation curves for the first fiber listed in the table.

Some effect of the treatment is apparent in each case but its magnitude is approximately the same in the control fibers as in the dyed fibers. This effect appears to be independent of rinsing with water after treatment, as shown by data on the last fiber listed in the table. In this csae, the fiber was treated and then extended in sulfuric acid solution without rinsing. These results indicate that the presence of dye in these experiments had no appreciable effect on the elastic properties of the nylon. The considerably decreased load required in the 7th extension as compared to the 4th extension, however, indictates some deterioration of the fibers at pH 1 under the dyeing conditions applied.

It is concluded from the data presented above that nylon can be dyed with acetic, formic, and sulfuric acids without any marked effect on its tensile properties if the pH is above 1.6 and the dye concentration not too high.

Preferential Sorption

The literature on the dyeing of nylon contains a number of references to the phenomenon of the influence of one dye upon the absorption of another dye from the same dye bath. Similar behavior has been observed in the case of wool *(11)*. The use by various authors of terms such as "blocking", "shut-out", "saturation" and "incompatibility" to describe this phenomenon without proper definition has led to considerable confusion and misunderstanding as to their meaning. It is believed by the present authors that "preferential sorption" affords a more proper description and therefore this term will will be used in the present paper.

A dye A is said to be preferentially sorbed in the presence of a second dye B if the presence of A in the dye bath with B results in the sorption of B by the fiber to a lesser extent than would have been observed under the same dyeing conditions had A not been present. Preferential sorption implies the presence of more than one dye in the same dye bath. Each dye used in combination may be sorbed as when used alone, or one dye may affect the sorption of another. The factors associated with the sorption of dye by nylon are saturation value (the amount of dye that can be sorbed), rate (speed at which dye is sorbed), and affinity (the chemical or physical force which binds the dye to the nylon). The saturation value, rate and affinity depend upon the chemical and physical nature of the fiber, pH of the dye bath, dye concentration, liquor ratio, temperature, etc. Therefore, if any of these conditions are varied, the sorption characteristics may change. Under the same conditions, the sorption characteristics of nylon for two different dyes are quite likely to be different because of the individuality of dyes. Because of this fact, one dye may be sorbed to the partial or total exclusion of another and hence the reason for the choice of the term.

SEQUENTIAL DYEING OF CALCOCID ALIZARINE BLUE SAPG AND CALCOCID FAST RED A ON NYLON AT pH 2.3

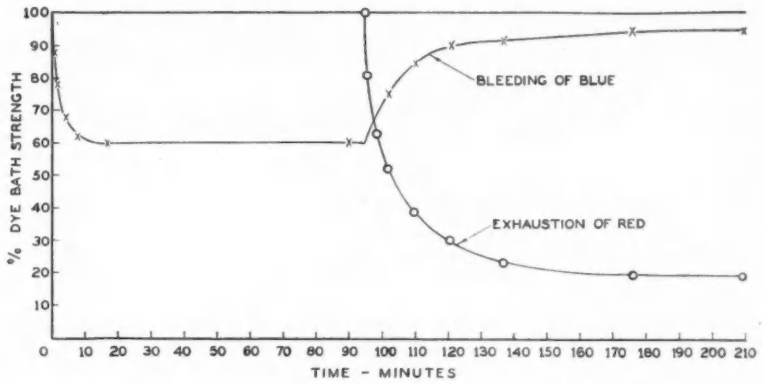


Figure 11

An example of preferential sorption is found in the use of Red A (C. I. 176) and Alizarine Blue SAPG (C.I. 1054) by Carlene, Fern, and Vickerstaff described previously *(8)*. In their experiment, neither Red A nor Blue SAPG were preferentially sorbed with formic acid at low dye concentrations. At the same pH, however, when the dye concentration was increased the Red A was preferentially sorbed. Similarly, when the pH was reduced the amount of Red A sorbed remained unchanged but the sorption of Blue SAPG increased.

A further investigation of these dyes has been made in the Dyeometer *(12)*, with which the dyeing rate curves shown in Figure 11 were obtained. Four grams of nylon was dyed at 200° F. for 1½ hours using 2½% of Calcocid Alizarine Blue SAPG, and 2½% of sulfuric acid conc. with a bath ratio of 100:1. At this time, 40% of the dye had been removed from the dye bath by the nylon, fibers of which removed for cross-sectional examination were well penetrated. Two percent of Calcocid Red A was then added to the same dye bath, and the dyeing continued at 200° F. for another 90 minutes. During this time, the dye bath content of Blue SAPG returned to 95% of its initial value, while the exhaustion of Red A proceeded to 80%. This result indicates the replacement of Blue SAPG by Red A, due to the preferential sorption of the latter by the nylon under the conditions of the dyeing.

An investigation has also been made of a number of dyes reported in the literature to show preferential sorption. It appears that in many cases the effect was obtained because of the specific dyeing conditions applied. We have found that many of these dyes exhibit poor sorption under the stated conditions when dyed alone, and in such cases the presence of a second dye in the combination is not responsible for the lack of sorption of the first. Under conditions of lower pH, higher temperatures and longer periods of dyeing the combination shade that would normally be expected is obtained because under these dyeing conditions the sorption of the first dye is increased. In the experiments described below, the dye which is included in the dyeing to determine whether a given dye is preferentially sorbed in its presence, is termed the "contrast" dye.

Fifteen dyes which have been referred to in the literature as exhibiting the property of preferential sorption on nylon have been examined in the present study. These are:

Dye	*Colour Index or Prototype No.*
Wool Fast Blue BL	833
Wool Fast Blue GL	833
Milling Fast Violet BC	833
Sulphon Cyanine 5R	289
Sulphon Cyanine G	288
Sulphon Acid Blue R	208
Sulphon Acid Blue B	209
Neutral Black 2B	304
Fast Black B	307
Fast Black 2B	307
Naphthol Blue Black	346
Fast Red A	176

Dye	Colour Index or Prototype No.
Chrome Red ECB.....	652
Blue 2G (metallized).....	Pr. 144
Pink N (metallized).....	Pr. 326

This group includes acid, milling, neutral dyeing, metallized and chrome dyes. Each dye was studied alone and in combination with one or other of two contrast dyes, Alizarine Cyanine Green (C. I. 1078) and Metanil Yellow (C. I. 138). These two dyes were also studied alone to determine their dyeing characteristics under the various conditions of time, temperature and pH used throughout the investigation. The choice of contrasting dye in each case was designed to render more evident, slight variations in exhaustion and color development.

Five series of experiments were carried out according to the following general procedure: Four 2½-gram pieces of nylon were placed in separate Launder-Ometer jars each containing 300 ml. of water and 1% of the dye under examination for preferential sorption properties. In series A, the temperature was raised to 212° F. slowly and run at this temperature for 30 minutes. One piece of nylon was then removed and the dye bath adjusted to 225 ml., after which an addition of 2% glacial acetic acid on the weight of the remaining nylon was made. The dyeing was continued at 212° F. for 30 minutes at which time a second piece of nylon was removed, the dye bath adjusted to 150 ml. and 2% formic acid (90%) on the weight of the remaining nylon was added. Dyeing was continued for a further 30 minutes, at which time 2% sulfuric acid conc. was added after the removal of a third piece of nylon and adjustment of the bath volume to 75 ml. The remaining piece was run for 30 minutes longer. All dyed samples were rinsed thoroughly and dried.

Series B, C, D and E were set up with single 5-g. pieces of nylon and 150 ml. of water containing 1% of the same dye as in Series A. After raising the temperature slowly to 212° F. and running at this temperature for 30 minutes without acid, ½% of the contrast dye was added to B, and 2% acetic acid was added to C, D and E. After a further 30 minutes dyeing at 212° F., 2% acetic acid was added to B, ½% of contrast dye was added to C and 2% formic was added to D and E. Thirty minutes later 2% formic acid was added to B and C, ½% contrast dye to D and 2% sulfuric acid to E. After a further 30-minute interval 2% sulfuric acid was added to B, C and D while ½% contrast dye was added to E. All pieces were rinsed and dried after a further 30 minutes' dyeing. Comparisons of the final shades give no indication of the preferential sorption of any of the dyes in any series, including that in which the contrast dyes were present in the neutral bath. Some of the dyes studied were not appreciably sorbed under neutral conditions.

In addition, series of dyeings at constant temperature were made on nylon with 2% Calcofast Wool Blue 2G (Pr. 144) and 1% Calcofast Wool Yellow R, both alone and in combination. The Blue 2G type has been said to exhibit preferential sorption properties. The dyeings were carried out for a period of 1 hour at temperatures of 180° F., 190° F., 200° F., and 212° F., with pH values in the range 1.8 to 3.0, as established by 4% formic acid 90%, and 4% and 6% sulfuric acid conc. A liquor ratio of 30 to 1 was maintained throughout. The dyeings and exhausted dye baths were measured spectrophotometrically, and the data obtained are given in Table XXII.

The exhaustion data reveal in all cases that in combination, the amount of either dye sorbed by the fiber is less than that observed when it is dyed alone under the same conditions. This defect in sorption, however, is much greater for Yellow R than for Blue 2G at a pH in the range 1.8 to 2.3, while the data obtained at pH 2.7 to 3.1 (formic acid) do not indicate a significant preference in sorption. Reflectance data, on the other hand, indicate preferential sorption of the Blue 2G in all cases, frequently indicating even increased sorption in the presence of the Yellow R. The latter phenomenon is slight, however, in the higher pH range studied. Some variation in the magnitude of the sorption defect is noted, but in general the latter appears to be independent of temperature.

Further experiments were run using 1% Calcocid Fast Blue GL (C.I. 833) in combination with 2% of one of the following yellows as a contrast dye, Calcocid Milling Yellow 2GC Conc. (C.I. 642), Calcocid Milling Yellow 5GC Conc. (C.I. 642), Calcocid Fast Yellow 2G (C.I. 639), Calcomine Brilliant Paper Yellow Conc. (C.I. 364), or 1% Calcocid Yellow MCG (C.I. 640). These were dyed both separately and in combination under two sets of conditions: (1) 10% ammonium sulfate (pH = 6,3 approx.) and (2) 1.4% glacial acetic acid (pH = 4.0-4.5). With the five contrast yellows used, Calcocid Blue GL showed apparent preferential sorption only when dyed with Calcocid Yellow MCG and Calcocid Fast Yellow 2G. The data obtained in the study of Calcocid Blue GL alone and in combination with the Yellow 2G are given in Table XXIII.

Some evidence of preferential sorption in the dyeing with ammonium sulphate is noted in the slightly lower exhaustion of the Yellow 2G in the presence of Blue GL. A similar and more marked effect is seen in the data of the dyeings with acetic acid. The effect is not always apparent to the eye but reflectance values are in general agreement with the exhaustion measurements. It should be noted also in this example that neutral dyeing conditions are unfavorable to the sorption of the Yellow 2G, and hence a comparison between the dyeings at the two different pH values is not to be interpreted as due to preferential sorption.

Influence of Physical Differences

Nylon after extrusion is referred to as "undrawn fiber". When it is stretched the point is reached at which it can be drawn or extended 300% or more without ap-

TABLE XXII

		6% Sulfuric Acid Conc.					4% Sulfuric Acid Conc.					4% Formic Acid 90%				
		% Color Value		% Exhaust.			% Color Value		% Exhaust.			% Color Value		% Exhaust.		
	Temp.	Bl.	Yel.	Bl.	Yel.	pH	Bl.	Yel.	Bl.	Yel.	pH	Bl.	Yel.	Bl.	Yel.	pH
2% Calcofast Wool Blue 2G	180° F.	69		61		2.00	69		65		2.20	69		62		3.00
	190° F.	76		75		1.95	78		75		2.10	78		80		3.00
	200° F.	86		87		1.75	86		87		1.90	86		98		2.75
	212° F.	86		91		1.80	93		96		2.20	100		92		2.65
1% Calcofast Wool Yellow R	180° F.		60		74	2.00		60		74	2.25		74		91	3.00
	190° F.		65		77	2.00		69		78	2.20		84		94	3.15
	200° F.		75		79	1.75		80		88	1.90		92		94	2.70
	212° F.		80		79	1.80		87		88	2.30		100		97	2.80
2% Calcofast Wool Blue 2G 1% Calcofast Wool Yellow R	180° F.	66	35	49	43	1.80	67	43	49	45	2.20	63	47	44	58	2.90
	190° F.	84	44	67	45	1.80	90	52	63	45	2.15	85	59	61	67	3.05
	200° F.	95	51	77	52	1.80	96	53	78	53	1.95	90	62	67	70	2.90
	212° F.	100	49	88	51	1.80	100	52	83	53	2.30	100	62	80	74	2.85

TABLE XXIII

NYLON	10% AMMONIUM SULPHATE					1.4% ACETIC ACID				
		% Color Value		% Exhaustion			% Color Value		% Exhaustion	
	pH	Blue	Yellow	Blue	Yellow	pH	Blue	Yellow	Blue	Yellow
1% Calcocid Fast Blue GL										
180° F.	6.20	80		98		3.95	85			
190° F.	6.30	83		98		3.95	91			
200° F.	6.25	86		99		3.95	96			
212° F.	6.30	90		99		4.00	100			
2% Calcocid Fast Yellow 2G										
180° F.	6.40		32		8			103		
190° F.	6.35		38		12	4.45		100		95
200° F.	6.30		45		16	4.55		100		92
212° F.	6.35		45		17	4.55		100		91
1% Calcocid Fast Blue GL										
2% Calcocid Fast Yellow 2G										
180° F.	6.45	80	7	98	6	4.30	81	85		
190° F.	6.35	92	26	98	9	4.30	84	85	99	74
200° F.	6.35	100	36	99	14	4.30	91	85	99	86
212° F.	6.40	92	32	98	14	4.30	98	82	99	81

preciable increase in load. After this treatment the fiber exhibits greatly increased tensile strength. Commercial nylon is subjected to a drawing operation during manufacture and is set by heat after the operation. The fiber is then relatively stable at temperatures lower than this setting temperature but is subject to further modification if the temperature is raised appreciably above it. These physical modifications in the nylon fiber are reflected in differences in dyeing properties. Similar effects are well known in the case of viscose rayon *(13)*, and the control of variables in rayon manufacture is important in securing uniform dyeing properties.

The influence of these physical differences in nylon in its dyeing behavior depends to some extent upon the dye used. The acetate dyes are least affected, while with other dyes variations in shade are obtained, resulting in barre effects, warp streaks, etc. When drawn nylon is relaxed as a result of heating to a temperature sufficient to soften it, shrinkage takes place and such heated portions will dye a much deeper shade than material which has not been subjected to the same treatment. Nylon which is not uniformly shrunk during setting or in preparation for dyeing will not dye uniformly. If during the setting or dyeing period variations in tension occur, these variations will be apparent in the shade of the dyed material. In the setting of piece goods, parts of selvedges are often under greater tension than the rest of the piece. When this occurs, marked variation in shade may be noted at the selvedges and adjacent areas. For example, a combination of Calcocid Blue GL and Calcocid Yellow MCG will dye the piece green with parts of the selvedge chiefly blue in shade, due to the fact that the blue dyes the selvedge and the body uniformly, whereas the yellow does not dye those parts of the selvedge which were under greater tension during setting.

Acknowledgments

The authors acknowledge the help received from their associates in obtaining the experimental data and especially the assistance of Dr. L. H. Turl and Dr. H. R. McCleary during the preparation of the text of this paper.

References

(1) Watkins, W. H., Royer, G. L., and Millson, H. E., Amer. Dyes. Rptr. *33*, 52, (1944).
Millson, H. E., Watkins, W. H., and Royer, G. L., Amer. Dyes. Rptr. *36*, 45, (1947).
Royer, G. L., Millson, H. E., and Amick, C. A., J. Soc. Dyers Col. *63*, 214, (1947), also Amer. Dyes. Rptr. *36*, 425, (1947).
Millson, H. E., Royer, G. L., American Dyes. Reporter *31*, 271, (1942.
(2 Vickerstaff, T. J., Soc. Dyers Col. *59*, 92-101, (May 1943).
(3) Fidell, L. I., "Nylon", Calco Technical Bulletin No. 676, Calco Chemical Division, American Cyanamid Company, Bound Brook, New Jersey, (1943).
(4) Boulton, J., J. Soc. Dyers Col. *62*, 65, (1946).
(5) Peters, R. H., J. Soc. Dyers Col. *61*, 95, (1945).
(6) Stearns, E. I., Amer. Dyes. Rptr. *33*, 1, (1944).
(7) Royer, G. L., Maresh, C., and Harding, A. M., "Microscopical Techniques for the Study of Dyeing," Calco Technical Bulletin No. 770, Calco Chemical Division, American Cyanamid Company, (1945).
(8) Carlene, P. W., Fern, A. S., and Vickerstaff, T., Reprints of the Society of Dyers and Colourists Symposium on Recent Advances in the Theory and Practice of Dyeing, Sept. 25-27, 1947, Blackpool, England.
(9) Loasby, G., J. Tex. Inst. *34*, 45, (1943).
(10) Sookne, A. M., and Rutherford, H. A., Journal Research Nat. Bur. Stand., *31*, 25, (1943).
(11) Millson, H. E., Amer. Dyes. Rptr. *34*, 284, (1945).
(12) Kienle, R. H., Royer, G. L., and McCleary, H. R., Text. Research J., *16*, 616, (1946).
(13) Royer, G. L., McCleary, H. R., and De Bruyne, J. M. A., J. Soc. Dyers Col. *63*, 254, (1947); also Text Research J., *17*, 438, (1947).

Discussion

Chairman Armstrong: Thank you Mr. Fidell.

In order to keep on schedule, we shall have to limit the questions to one or two. I am sure Mr. Fidell will try to answer them.

J. A. Woodruff: I wondered how you got the high temperature in the Launderometer?

Mr. Fidell: The Launderometers are set up with a steam line connection. In conjunction with the electrical heating elements and the insulated lining the temperature of the water in the Launderometer can be raised to the boil rather rapidly or at a controlled rate if desired. The dyebath at the ratio of 30 to 1 occupies about 1/3 of the capacity of the jar and is in constant agitation and contact with the heated surface of the inside of the jar. Under the circumstances the transference of heat from the water to the dyebath is rather rapid.

The reason you do not get any leakage or change in volume of the dyebath is that we replaced the glass covers of the jars with cellophane covered rubber stoppers and fastened the jars in with screw clamps. The pressure that is generated inside the jars with rise in temperature is held with no loss of the dyebath volume.

Mr. Woodruff: You know that the temperature is 212° F. in the jar?

Mr. Fidell: We have not measured the temperature inside the jars. When I said 212° F. that is the temperature of the liquid in which the jars are circulated.

When you raise the temperature of the water in the Launderometer to the boil, while the jars are rotating in it, the temperature in the jars is pretty close to 212° F., that is within one or two degrees.

The temperature of 212° F. is indicated by the thermometer inserted in the water bath. You don't have that alone as an indication since you can see the water boiling when you lift the cover of the Launderometer, besides the excess steam is exuding from beneath the cover, throughout the period after the thermometer indicates that a temperature of 212° F. has been reached. The automatic thermostatic control works up to temperatures of 220° F.

I think in practice you will find that when you are dyeing or processing at about 205° F. or better, you get results due to mechanical action which in most

cases will come close to what you get in the laboratory under the conditions used in this study.

Mr. Woodruff: Did you get the same high rate of diffusion as you would in applying on viscose the direct dyes that you used,

Mr. Fidell: I don't know what the comparison would be with the dyeing of direct dyes on cellulose, because they do not all behave the same on nylon. You will note that the blue we used as an illustration, Calcomine Sky Blue FF Extra Conc. showed little diffusion into the fibers, and was ring dyed even after 90 minutes at 212° F. with sulfuric acid; whereas the direct yellow that followed, Calcodur Yellow RL showed that complete diffusion had taken place at the higher pH with acetic acid as well as at the lower pH with sulfuric acid.

In order to answer your questions as to the comparison of the diffusion of direct dyes on viscose with that on nylon you would have, I think, to take specific dyes and make comparisons of cross sections on both fibers, rather than to compare classes.

W. Holst: In studying the effect on the tensile strength of sulfuric acid dyes, are those tests made soon after dyeing or so as to give consideration to the effect of time?

Mr. Fidell: In this particular work the tensile strength measurements were made immediately, but we have done some other work in which the dyeings were put away for a period of a year after they had been dyed with sulfuric acid, not at a pH of 1, but at 1.6 or higher, and the indications are that time does not make any difference. Our studies show that approximately 0.22% of sulfuric acid was taken up by the nylon. That percentage could not be accounted for in titrating the dyebaths after dyeing, and was found by titrating the nylon in distilled water with alkali.

The tensile strength tests, after having those pieces put away for one year, indicated there was about a 10% average loss in all the pieces including the control which had not been treated with acid.

So the indications are that the acid itself at those pHs and conditions referred to in the paper have no harmful effects on the tensile properties of the nylon.

CALENDAR

PHILADELPHIA SECTION

Meetings: April 9, May 14 (Kugler's, Philadelphia); Outing: June 11 (Atlantic City Country Club, Northfield, N. J.).

NEW YORK SECTION

Meeting: March 12 (Hotel New Yorker, N. Y.); May 7 (Swiss Chalet, Rochelle Park, N. J.); Outing: June 18 (North Jersey Country Club).

PIEDMONT SECTION

Meetings: Apr. 3 (Robt. E. Lee Hotel, Winston-Salem, N. C.): June 18 (Ocean Forest Hotel, Myrtle Beach, S. C.).

NORTHERN NEW ENGLAND SECTION

Meetings: March 19 (Boston); April 16 (Lowell Textile Institute); May 21, June 11 (Outing); September 24 (Andover Country Club); November 19.

SOUTHEASTERN SECTION

Meetings: March 13 (Highland Country Club, LaGrange, Ga.); July 24 (Atlanta, Ga.); September 25 (Columbus, Ga.); December 4 (Atlanta, Ga.).

SOUTH CENTRAL SECTION

Meeting: April 10 (Patten Hotel, Chattanooga).

SUB-COMMITTEES

Meeting: April 1 (Hotel Pennsylvania, New York).

COUNCIL

Meeting: April 2 (Hotel Pennsylvania, New York).

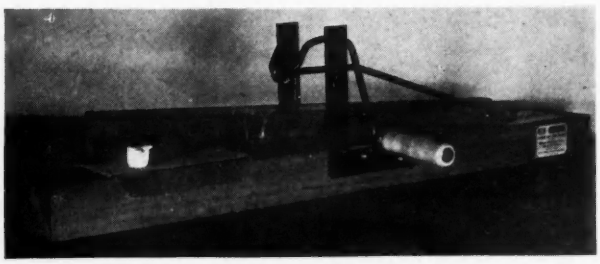
RESEARCH COMMITTEE

Meeting: April 2 (Hotel Pennsylvania, New York).

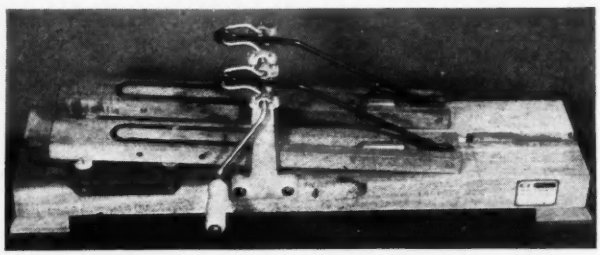
Crockmeters and Crockmeter Cloth

Revised Prices

Regular Crockmeter	$20.00
Regular Crockmeter (with automatic counter)	30.00
Duplex Crockmeter	50.00
Crockmeter Squares (500)	1.50
Crockmeter Cloth (96 x 100), by the yard	.75



Regular Crockmeter



Duplex Crockmeter

Available from the National Secretary

EMPLOYMENT REGISTER

This column is open for four insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers, who can obtain further information from the Secretary.

48-1

Education: B.S., Rhode Island State College.

Experience: Chemist, print works.

Age 33; married; references; position in New England desired.

SANDOZ PRESENTS *The color achievement of the month*

Cover Girl Colors BY BARBOUR

Bright and *saucy* are the adjectives you'd use to describe the colors selected by Barbour Mills for these two fleece coats tailored by "Kitten's Ear" and modelled by two teen-age cover girls at famous Wayside Inn.

For these coats Barbour wants colors that will sell . . . will hold up in service . . . and can be handled efficiently and economically in the dyeing process. That is why Barbour—like so many other textile leaders—insists upon the quality that Sandoz represents.

Among the Sandoz color achievements is:

ALIZARINE LIGHT BLUE 5GL (Pat.) a new and outstanding clear, greenish acid blue with similar properties to those of its predecessor, Alizarine Light Blue 4GL—for years the standard for fastness-to-light and level dyeing in acid blues. It provides unsurpassed fastness in peacock, teal and turquoise shades and—with Xylene Light Yellow 2G—faster greens.

For acid, chrome or direct dyes . . . or auxiliary chemicals . . . for both natural and synthetic fibres . . . be guided by the successful "color achievements" you see in these Sandoz advertisements.

SANDOZ CHEMICAL WORKS, INC., 61 VAN DAM STREET, NEW YORK 13, N. Y.

Application laboratories and stocks at Boston, Philadelphia, Charlotte, Los Angeles, Toronto. • Other branches at Providence, Paterson, Chicago.

SANDOZ *thinks ahead with textiles*

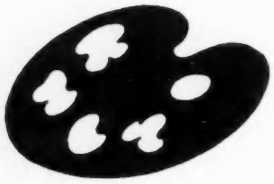
SANDOZ

DYESTUFFS

DIRECT - ACID - CHROME
FORMALDEHYDE - ACETATE

UNIFORMITY

With a background of many years of approval before the bar of public opinion.



PURITY OF COLOR

Custom made from best quality raw materials, producing products of high standing in the trade.

Stocks Carried by All Dyestuff Distributors in All Textile Centers

YOUNG ANILINE WORKS

OFFICE and FACTORY
2701-2733 Boston St., Baltimore, Md.

PATERSON OFFICE
50 E. 13th Street, Paterson, N. J.

BUY — SELL — TRADE

DYESTUFFS

DIRECT — VAT — CHROME
ACID — NAPHTHOL — ETC.

CHEMICALS

CAUSTIC SODA — SODA ASH,
Sodium Sulphide, Beta Naphthol, Formic Acid, Titanium Dioxide, etc.

SANDERS & SLOAT, INC.
180 Broadway New York 7, N. Y.
Phone: BEekman 3-5894
Cable: PORTRADERS

Uniformity

a BIG reason why
more and more Textile Mills are insisting upon these proved products

IDAHO
POTATO STARCH

* Magic Valley Processing Co., OF IDAHO
* St. Anthony Starch Co., Inc., OF IDAHO
* Menan Starch Company, Inc. OF IDAHO

Southern Representative
IRA L. GRIFFIN
P. O. Box 1576
Charlotte, N. C.

Western Representative
FRED BLOCK
% Willits & Co., Inc.
1 Drumm Street
San Francisco 11

POTATO & TAPIOCA DEXTRINES
RAPIDOGEN GUM
TAPIOCA FLOUR...SAGO FLOUR
LOCUST BEAN GUM
CASEIN...ANIMAL GLUE

★ SOLE DISTRIBUTOR
AMERICAN KEY PRODUCTS, INC.
"America's Largest Distributor of Potato Starch"
15 PARK ROW • NEW YORK 7, N. Y.

A COMPLETE LINE OF
DYESTUFFS
for all branches of
TEXTILE DYEING
AND PRINTING—
PAPER AND LEATHER
★
Specializing in fast colors
NOVA CHEMICAL CORPORATION
147-153 Waverly Place New York 14, N. Y.
WAREHOUSES IN NEW YORK and CHARLOTTE, N. C.

QUALITY RICHMOND PRODUCTS
MERCOPEN
For mercerizing
•
The mercerizing penetrant
which is water soluble
Faster Penetration
Easier rinsibility
No scum in caustic
Ask for samples
Southern office
617 Johnston Building,
Charlotte, N. C.
RICHMOND OIL, SOAP & CHEMICAL CO., Inc.
1041-43 FRANKFORD AVE., PHILADELPHIA 25, PA.

A New
Anionic Softener
ANCAT
502
DE PAUL
RESEARCH PROGRESS
Check
these advantages
of ANCAT 502
- Compatible with soaps, anionic compounds (duller), resin finishes.
- Will remain soluble in mildly acid solution, down to pH 5.
- Exhaustive on cotton, rayon, and wool in the same way as cationics.
- Finish produced is equal in feel and wash-resistance to the cationics.
- Excellent on white goods.
- May be used with gas inhibitors.

DE PAUL
PROGRESS THROUGH RESEARCH
CHEMICAL COMPANY, INC.
44-27 PURVIS STREET
LONG ISLAND CITY, NEW YORK

FOR AMERICAN INDUSTRY...

THE FINEST IN ALKALIES and related products

When your new product development or new process calls for the use of alkalies, SOLVAY, the largest makers of alkalies in America, is a source you can trust. . . . The quality of SOLVAY products—backed by intensive research and extensive experience—has resulted in sixty-seven years of continuous leadership in our field. This extensive knowledge of alkalies worked out by the SOLVAY Technical Staff is at *your* service to help you in new product development. We will welcome the opportunity to work on your chemical problems, in strict confidence, or co-operate with your own research staff. Why not call or write today? There is no obligation.

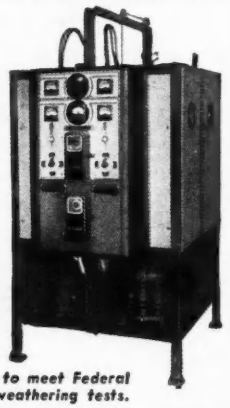
SOLVAY SALES DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street **New York 6, N. Y.**

WEATHERING TEST FOR TEXTILES

Weathering effects of sunlight, rain, heavy dew and thermal shock reproduced in the laboratory at an accelerated rate that reduces years of actual weathering to a few days of testing in the —

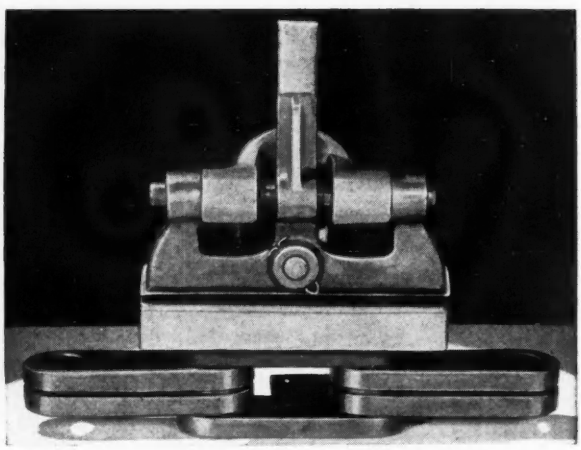
ATLAS TWIN-ARC WEATHER-OMETER

The Twin-Arc Weather-Ometer has full automatic control of light and water periods. The Atlas Cycle Timer unit can be set to reproduce any combination of weathering conditions. A direct reading thermal regulator, automatic shut-off switch and a running time meter is included on the control panel. After setting exposure cycle on the control panel the Weather-Ometer is safe to be left in continuous operation over night without attention except to replace carbons once in 24 hours.



The Atlas Weather-Ometer is required to meet Federal Specifications demanding accelerated weathering tests.

ATLAS ELECTRIC DEVICES COMPANY
361 W. Superior Street, Chicago 10, Illinois
Originators and sole manufacturers for over a quarter of a century. . . Weather-Ometers, Launder-Ometers, Fade-Ometers are the accepted standard accelerated testing machines all over the world.

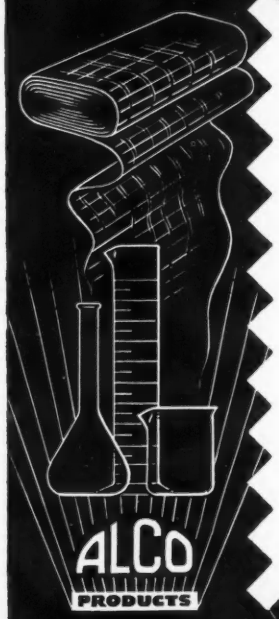


New Tenter Chain

With the new Butterworth "43" Chain, vibration is practically eliminated. Hardened steel construction reduces wear to minimum. Damaged clamps can be replaced by removing single bolt with only a few seconds shutdown.

H. W. BUTTERWORTH & SONS COMPANY
Serving the Textile Industry Since 1820
Main Office and Works: Philadelphia 25, Pa.

Butterworth



VULCANOLS

for sizing and finishing

VULCANOLS have proven to be efficient for the production of durable, flexible finishes on tickings, shade cloths, book cloths, baggings, pile fabrics, hair cloths, label cloths and carpets.

for starch sizing mixes

VULCANOLS are economical plasticizers and binders providing finishes of increased resistance to mechanical removal.

ALCO OIL & CHEMICAL CORPORATION
TRENTON AVE. and WILLIAM ST., PHILADELPHIA 34, PA.

SOUTHERN DISTRIBUTORS
WICA COMPANY INC.
CHARLOTTE, N.C.

The Fleet Line

CARBONIZING RANGE

This modern installation is typical of recent Riggs and Lombard Carbonizing Range production. Women's wear woolens pass at 10-40 yards per minute from the wooden* wet out box through the rubber lined* steel acid tank, pin type tenter dryer, infra-red baker and continuous crusher mill (not shown), to washers, dye kettles or fulling mills.

Construction in every part of this Carbonizing Range is in keeping with Riggs and Lombard's reputation for superior wet finishing machinery. The skyframe is a good example. It permits longer exposure to acid in a given floor space by increasing the vertical travel of the cloth. Even when the cloth is above the bath level, the excess acid runs down over it on its way back into the bath. Soaking is thus more effective and complete.

Here are other installation features of the Riggs and Lombard Carbonizing Range:

1. **Heavy squeeze-roll extractor for maximum results regardless of speed.**
2. **Hydraulic, automatic, speed control insures constant even tension.**
3. **Variable speed drive.**
4. **Intermediate rubber squeeze rolls, rubber* immersion rolls and top idler rolls.**
5. **Thorough, even, uniform drying at temperatures below the boiling point.**
6. **In many installations a continuous neutralizer completes the range operation.**

* These often are of polished stainless steel, with SMO used in acid tank.

CIRCULAR ON REQUEST

RIGGS AND LOMBARD INCORPORATED

FOOT OF SUFFOLK ST., LOWELL, MASS.

Shepard Chemical Corporation

EXPORTERS

DYESTUFFS CHEMICALS and ALLIED PRODUCTS

INQUIRIES INVITED ON ALL CHEMICAL EXPORT REQUIREMENTS

SHEPARD CHEMICAL
CORPORATION
117 Liberty St., New York 6, WOrth 4-3950
Cable Address: *SHEPCHEM* — All Codes

PENETRANTS • DETERGENTS • SOFTENERS • REPELLENTS • FINISHES

BURK-SCHIER

BURKART-SCHIER CHEMICAL CO., CHATTANOOGA, TENN.

• CLASSIFIED ADVERTISEMENTS •

CONFIDENTIAL EMPLOYMENT SERVICE—For Dyers, Chemists, Colorists, Managers, Superintendents and others seeking positions and for employers seeking men. Many positions paying attractive salaries open for capable men. Charles P. Raymond Service, Inc., 294 Washington St., Boston, Mass. Over 45 years in business.

WANTED

HOSIERY DYER for high grade commercial dyehouse in Philadelphia vicinity. Must be fully qualified in executive as well as dyeing ability. A lifetime opportunity with money no object to the right person. Applicant must be high grade, able to cope mechanically and temperamentally with all problems incidental to commercial dyehouse operation, and will take over going concern with all expertly trained help. Must have training and knowledge of highest type as person will be selected on a permanent basis, and must be able to successfully and productively dye and bleach all nylon deniers, rayon, cotton, silk, and or any combinations of the above.

Write Box No. 409.

POSITION WANTED: Textile chemist, college graduate, 10 years varied experience in research, development and production on all types of fibers from raw materials to finished product. Interested in position with possibilities for future advancement either in research, pilot plant or production. Philadelphia area desired, age 36 years. Write Box No. 408.

POSITION WANTED: Registered Patent Agent, Chemist, two scientific degrees, extensive patent experience in chemical and mechanical arts, available for part-time work. Write Box No. 406.

Established manufacturer of textile detergents offers exclusive agency arrangement in New England area to representative with clientele. Write Box No. 399.

POSITION WANTED: As hosiery dyer possessing laboratory research and color control. Seventeen years as head dyer for a large hosiery manufacturer in the South. Excellent references as to ability and character. Write Box No. 402.

TECHNICAL SALES REPRESENTATIVE: Wanted by well-established sizing specialists to help develop line of textile auxiliaries and finishes. Require: young man, at least 5 to 10 years' experience in wet processing and finishing, good sales personality. Good salary for right man, excellent future. Southeast. Write Box 344.

WANTED CHEMIST: Experienced in bleaching, dyeing, printing and finishing cotton goods, to take charge of laboratory and quality control. Location—New England. Write Box 369.

POSITION WANTED: Cotton and rayon piece goods finishing control chemist with 23 years' experience. College graduate, able to assume charge of laboratory. Prefer location north of Virginia along seaboard. Write Box 349.

WANTED

TRICOT KNIT GOODS DYER

Must be capable of supervising dyehouse with production of approximately sixty thousand pounds per week on both underwear and outerwear fabrics. Excellent opportunity for the right man. Prominent company. Qualified applicants should submit full information giving experience, age, marital status and references.

Write Box No. 397

POSITION WANTED: Textile chemist 28. Experience in dyeing, finishing acetate, cotton and rayon piece goods. Supervisor of package dyeing plant and laboratory. Desires position in some supervisory capacity. Write Box No. 404.

• CLASSIFIED ADVERTISEMENTS •

WANTED: Experienced Textile Chemist for Dyestuff laboratory in Canada. Excellent opportunity to aggressive party. Must be capable of analyzing dyestuffs and matching shades on various fabrics. State age, experience, and salary required. Write Box No. 410.

POSITION WANTED: Full Fashion hosiery dyer with 19 years experience now employed by a branded mill is interested in going into demonstration and sales work as a trouble shooter. Prefer southern territory. Write Box No. 411.

WANTED: Package Dyer having technical and some practical experience to eventually take over responsibility of yarn dyeing department if capable. Location Middle West. Our organization knows of this ad. Write Box No. 405.

WANTED SALES REPRESENTATIVE: Large dyestuff organization has opening in upper and Western New York State for aggressive salesman with technical background. Prefer man with car currently residing in area. Write Box No. 407.

Technical man wanted for sales and demonstration work in New England. Experience in textile printing and finishing desirable. Excellent opportunity with large chemical manufacturers. State age, experience and education. Write Box No. 385.

TEXTILE CHEMICAL

SALESMEN

. . . Increase Your Earnings

Reputable manufacturer of textile chemical specialties seeks salesmen with well-established following in Northern and Southern New England territory. No canvassers —but men who can produce immediate business. Unusually attractive financial arrangements are available to qualified men.

Write today —

SUITE 1105
130 West 42nd St.—New York 18

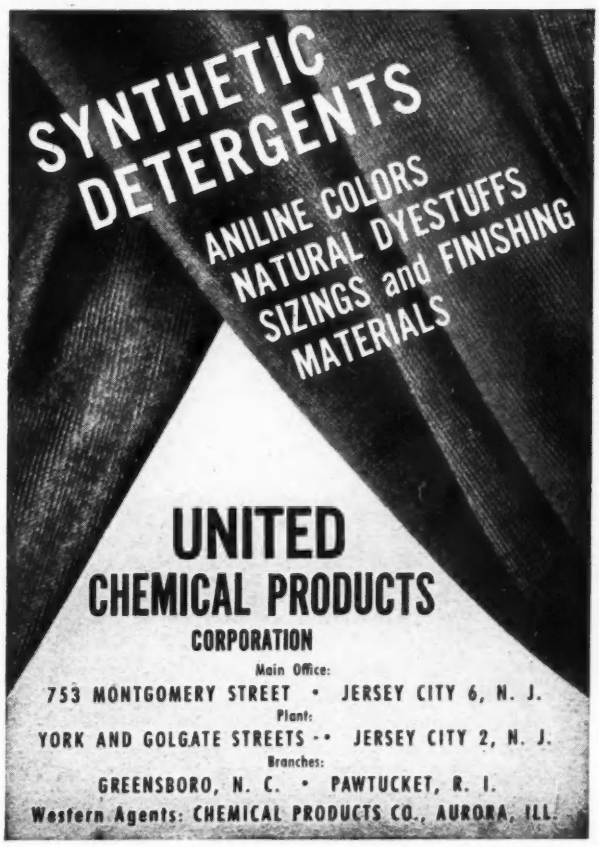
Elementary Organic Chemistry

by DR. LOUIS A. OLNEY

Now available at

$2.00 per copy

TEXTILE ASSOCIATES, INC.
LOWELL TEXTILE INSTITUTE
LOWELL, MASSACHUSETTS



Complete *Your* reduction-picture

with

VIRGINIA

$Na_2S_2O_4$

SODIUM HYDROSULPHITE

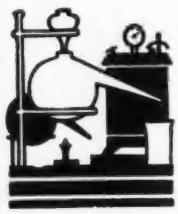
"Virginia" Sodium Hydrosulphite is a widely used reducing agent for cotton vat dyeing, stripping, and decolorizing operations. This concentrated $Na_2S_2O_4$ is a stable, free-flowing, uniformly crystalline white powder, rapidly soluble in water. It is notable for its carefully controlled particle-size and complete solubility . . . 100 pounds of water at 68 degrees F. will dissolve 21.8 pounds of "Virginia" $Na_2S_2O_4$. Shipped in 250-pound steel drums. Your inquiry is invited. VIRGINIA SMELTING COMPANY, West Norfolk, Virginia. *Est. 1898.*

SULFUR DIOXIDE · SODIUM HYDROSULPHITE

VIRGINIA *Chemicals*

WEST NORFOLK · NEW YORK · BOSTON · DETROIT

AQUAKAL #77



A SYNTHETIC AMINE DETERGENT

•

REPLACES soap or portion of your Soap—for SCOURING piece goods, Cotton, Wool, Rayon, Acetate or Nylon.

Brighter colors due to the

PENETRATING and LEVELING qualities.

•

Excellent for Soaping Vats — not affected by hard water.

•

HYDROXY HAND CREAM—for the operators handling nylon to keep their hands smooth.

Kali MANUFACTURING COMPANY

Manufacturing Chemists

427 MOYER ST. PHILADELPHIA 25, PA.

LeaTex

The name that means leadership in

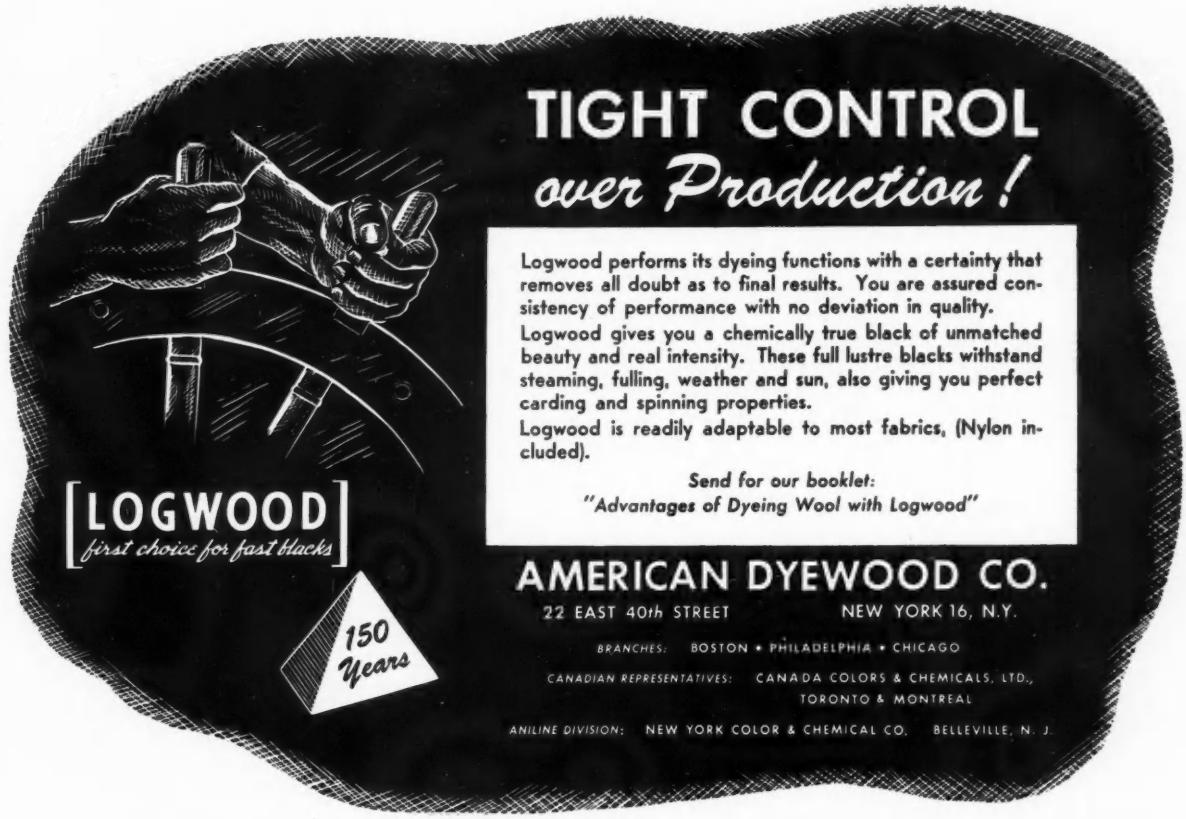
CHEMICAL SPECIALTIES

for the TEXTILE INDUSTRY

"Always Reliable"

LEATEX CHEMICAL COMPANY

2722 N. HANCOCK ST., PHILADELPHIA, PA.


TIGHT CONTROL
over Production!
Logwood performs its dyeing functions with a certainty that removes all doubt as to final results. You are assured consistency of performance with no deviation in quality.
Logwood gives you a chemically true black of unmatched beauty and real intensity. These full lustre blacks withstand steaming, fulling, weather and sun, also giving you perfect carding and spinning properties.
Logwood is readily adaptable to most fabrics, (Nylon included).
Send for our booklet:
"Advantages of Dyeing Wool with Logwood"
[LOGWOOD]
first choice for fast blacks
150 Years
AMERICAN DYEWOOD CO.
22 EAST 40th STREET NEW YORK 16, N.Y.
BRANCHES: BOSTON • PHILADELPHIA • CHICAGO
CANADIAN REPRESENTATIVES: CANADA COLORS & CHEMICALS, LTD., TORONTO & MONTREAL
ANILINE DIVISION: NEW YORK COLOR & CHEMICAL CO. BELLEVILLE, N. J.

DYESTUFFS— BOUGHT,(1) SOLD(2) OR EXCHANGED(3)

(1) If you have dyestuffs which you do not need, we will give you liberal prices for them.

(2) If you *need* dyestuffs, we may be able to help you. Obviously not all items are always available, but for these times we have a very fair stock on hand.

(3) Keyed to the current situation is our "TRADE" department. Through this we can occasionally make arrangements to exchange such dyestuffs as you may have in excess. Send us a list of your excess dyes. Specify either your selling price or those dyes you require in exchange. *All exchanges are made on the basis of dye house prices.*

Let us act as your dyestuff clearing house

CHEMICAL MAXIM ESTD 1903 CO., INC.

44 Cliff Street, New York 7, N. Y. • COrtlandt 7-4126
Cable Address "MAXIM" New York

QUALITY RICHMOND PRODUCTS

Less Handling with

AFTER CHLOR

Eliminates 3 to 5 handlings

Bleach with Hypochlorite Rinse and Use

AFTER CHLOR

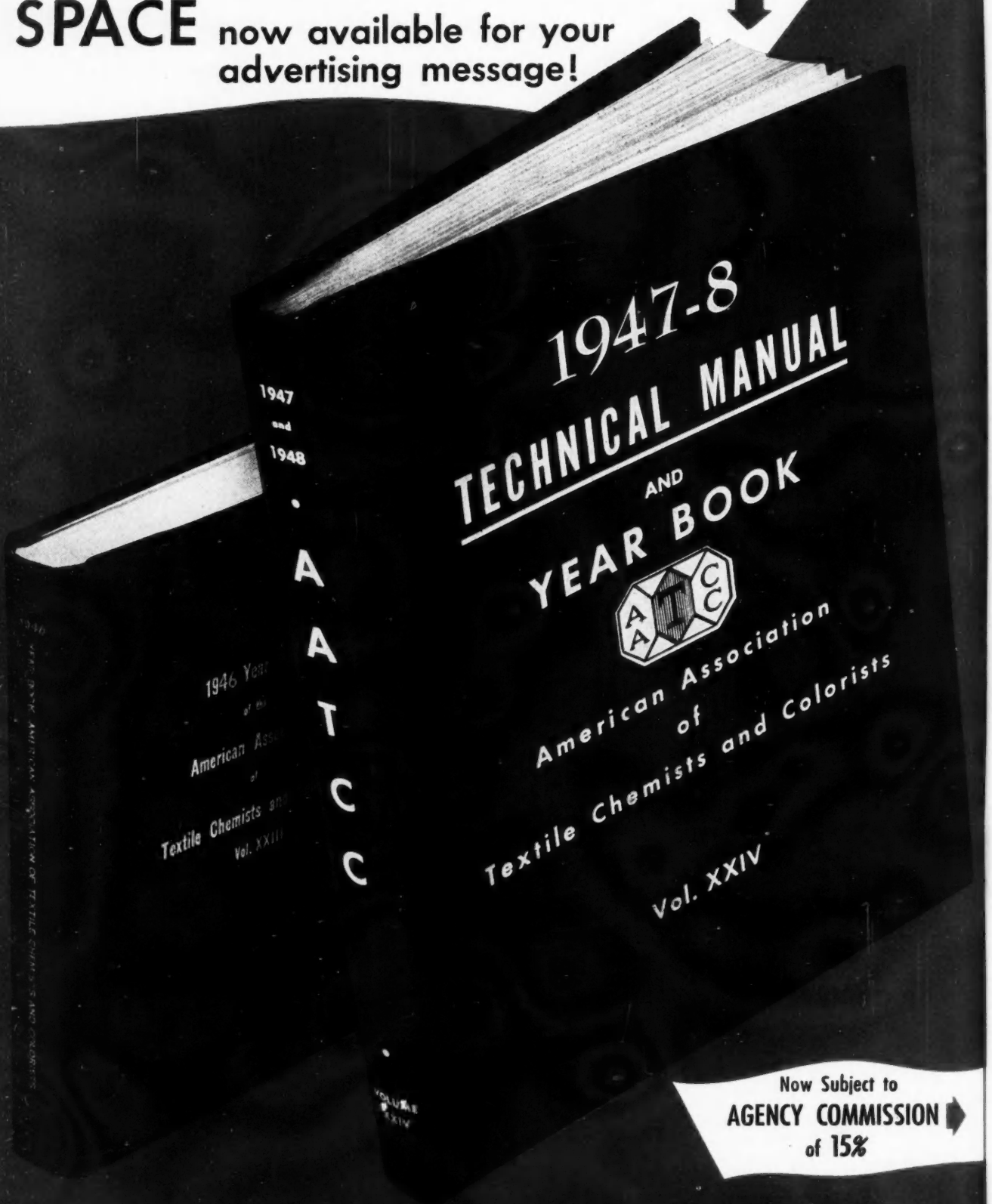
THAT'S ALL!

Write for FREE Sample

Southern Office
617 Johnston Building
Charlotte, N. C.

RICHMOND OIL, SOAP & CHEMICAL CO., Inc.
1041-43 FRANKFORD AVE., PHILADELPHIA 25, PA

Over 100% MORE TYPE SPACE now available for your advertising message!



Now Subject to
AGENCY COMMISSION
of 15%

THE INDEX OF COMPANIES WHO USED SPACE IN THE LAST EDITION IS A "WHO'S WHO" IN THE AMERICAN TEXTILE CHEMICAL INDUSTRY.

★

Full page—$200. Half page—$125.
Color—$60 net. Bleed—10% additional

MECHANICAL REQUIREMENTS

Full page type size—7″ wide x 10″ deep

Half page vertical—3⅜″ wide x 10″ deep

Half page horizontal—7″ wide x 4¾″ deep

Bleed—8¼″ x 11½″

Screen—110

Forms close May 1, 1948

Regular 7″ x 10″ advertising plates can be used—also regular vertical and horizontal half page plates. No quarter pages will be accepted.

★

Send space reservation to
HOWES PUBLISHING COMPANY
One Madison Avenue, New York 10, N. Y.

INDEX TO ADVERTISERS

A

Aktivin Division, Heyden Chem. Corp., The
Alco Oil & Chemical Corp.
Alrose Chemical Co.
Althouse Chemical Co.
Amalgamated Chemical Co.
American Aniline & Extract Co
American Aniline Products Co.
American Cyanamid Company
American Dyestuff Reporter
American Dyewood Co.
American Viscose Corp.
Analyte Instruments, Inc.
Aqua Sec Corporation
Arabol Mfg. Co.
Aridye Corp.
Arkansas Co., Inc.
Arnold, Hoffman & Co., Inc.
Atlas Color & Chemical Co.
Atlas Electric Devices Co.
Augusta Chemical Company

B

Barnes Tex. Associates, Inc.
Becco Sales Corp.
Bernard Color & Chemical Corp
Bick & Co., Inc.
Borden & Remington Co.
Borne Scrymser Co.
Bryant Chemical Corporation
Burkart-Schier Chemical Co.
Butterworth, H. W., & Sons Co

C

Calco Chemical Division, American Cyanamid Co.
Calgon, Inc.
Campbell, John, & Co., Inc.
Carbic Color & Chemical Co., Inc.
Carbide & Carbon Chemical Corp.
Celanese Corp. of America
Chemicolloid Laboratories, Inc.
Ciba Co., Inc.
Clarion Chemical Corp.
Colloids, Inc.
Commonwealth Color & Chemical Co.
Continental Chemical Co.

D

Darpro Chemical Corp.
Dexter Chemical Corp.
Dow Chemical Co.
Draper Soap Co.
Du Pont de Nemours & Co., Inc., E. I.
Dyestuff Division
Electrochemicals Dept.

E

Emery Industries, Inc.

G

Gaston County Dyeing Machine Co.
Geigy Co., Inc.
General Chemical Company
General Dyestuff Corp.
Givaudan-Delawanna, Inc.
Glyco Products Co., Inc.

H

Harrison, A., & Co., Inc.
Hart Products Corp.
Hercules Powder Company
Howe & French, Inc.
Houghton & Co., E. F.
Hunter Machine Co., James

I

Industrial Dyestuff Co.

K

Kali Manufacturing Co.

L

L. & R. Organic Products Co., Inc.
Laurel Soap Mfg. Co., Inc.
Leatex Chemical Company
Lewis, John D., Inc.
Lowell Textile Institute

M

MacMillan Company, The
Mann, George & Co., Inc.
Mathieson Alkali Wks., Inc.
May, Otto B., Inc.
Maywood Chemical Works
Metakloth Company
McCabe Chemical Co.
M.K.M. Hosiery Mills, Inc.
Monsanto Chemical Co.
Morton Machine Works

N

National Aniline Division, Allied Chemical & Dye Corp.
National Oil Products Company
Nova Chemical Corp.
Nyanza Color & Chemical Co., Inc.

O

Onyx Oil & Chemical Co.

P

Pabst Sales Co.
Paisley Products, Inc., of N. Y.
Peerless Color Co.
Penna. Salt Mfg. Co.
Pomona Mfg. Company
Prior Chemical Corp.
Procter & Gamble
Proctor & Schwartz, Inc.

R

Refined Products Corp.
Richmond Oil, Soap & Chemical Co.
Rodney Hunt Machine Co.
Rohm & Haas Co.
Rosentwist & Gorner
Royce Chemical Co.
Ruger Textile Color Co.
Rumford Chemical Wks.

S

Sagamore Color & Chemical Co.
Sandoz Chemical Works, Inc.
Scholler Bros., Inc.
Scott Testers, Inc.
Siegel Chemical Co., Inc.
Solvay Sales Corp.
Somerset Color & Chemical Co., Inc.
South Florida Test Service
Speizman Co., Inc., Morris
Standard Brands, Inc.
Standard Chemical Products, Inc.
Stein, Hall & Co., Inc.
Surpass Chemical Co., Inc.
Sylvania Div., American Viscose Corp.
Synthetic Chemicals, Inc.

T

Tennessee Eastman Corp.
Tex-Chem. Co.
Textile Aniline & Chemical Co., Inc.
Textile Book Publishers, Inc.
Titan Chemical Products, Inc.
Thomas Co., Arthur H.

U

Ultra Chemical Works, Inc.
United Chemical Products Corp.
United Piece Dye Works
United States Dyestuff Corp.

V

Van Vlaanderen Machine Co.

W

Wallerstein Co., Inc.
Warwick Chemical Co.
Watson-Park Co.
Welch, Holme & Clark Co., Inc.
Wolf & Co., Jacques

Y

Young Aniline Wks., Inc.

Z

Zinsser & Co., Inc.
Zurn, O. F., Co.

10 PRODUCTS of PROVEN DEPENDABILITY

WHICH SHOULD WARRANT YOUR ATTENTION

*AQUAROL: A water repellent for processing woolen, cotton and rayon fabrics, also produces excellent results in splashproofing or finishing all types of hosiery.

*PARAMINE T A: A cation active softener for processing cotton and rayon cloth to obtain a soft, smooth, pleasing finish.

ANTHOMINE: Auxiliary used in all wool dyeing processes to produce a uniform shade and impart a soft pleasing hand to stock, yarn and cloth. Improves exhaustion of dye bath and increases color yield. Very effective for levelling shade of tippy and mixed wools.

*PARAPON S A: A highly efficient leveler and softener for dyeing and finishing all types of yarn, cloth and hosiery to produce a uniform dyeing and a soft full hand.

*ARIPEL F S: Finish and gas inhibitor for processing dyed acetate rayon—produces a soft, full feeling finish and prevents gas fading of the color.

*LANITOL F: A synthetic detergent possessing exceptional scouring and washing properties for processing wool, cotton, rayon or nylon.

*ALGEPON V A: Auxiliary used in dyeing vat colors to retard reoxidation of the reduced bath and produce a solid and uniform shade—also effective in stripping vat dyeings.

*CULOFIX: Used as an after treatment in last rinse to prevent bleeding of direct dyed cotton or rayon in water.

*DIAZONOL A C: For boiling out cotton cloth in pressure or open kiers to produce greater absorbency and cleaner material. Excellent for pre-boiling knitted cloth in preparation for chlorine bleach. Also used with good results for boiling out cotton or rayon cloth on the jig.

*TETRANOL: A rapid wetting and penetrating agent. Active in acid, alkaline and salt solutions and not affected by hard water, may be used in all types of dyeing operations to insure positive penetration of color and a uniform and solid shade.

And a complete line of Oils, Chemicals, Softeners and Finishes for Wet Processing All Textile Fibres

*REG. U. S. PAT. OFF.

ARKANSAS CO., INC.

Newark, New Jersey

Manufacturers of Industrial Chemicals for Over 40 Years

INDEX TO ADVERTISERS

Aktivin Div., (Heyden Chem. Corp.)	
Alco Oil & Chem. Corp.	XXXIII
Althouse Chemical Co.	
Amalgamated Chemical Corp.	XIV
American Aniline Products, Inc.	IX
American Cyanamid Co. (Ind. Chem. Div.)	Second Cover
American Dyewood Company	XXXVII
American Key Products, Inc.	XXX
Anders Chemical Corp.	
Arkansas Company, Inc.	XL
Armour and Co.	
Arnold, Hoffman & Co., Inc.	IV
Atlantic Chemical Co., Inc.	
Atlas Electric Devices Co.	XXXII
Becco Sales Corp.	Third Cover
Bick & Co., Inc.	
Blickman, Inc., S.	
Burkart-Schier Chemical Co.	XXXIV
Butterworth Sons Co., H. W.	XXXII
Calco Chemical Division American Cyanamid Co.	
Calgon, Inc.	
Campbell & Co., Inc., John	
Carbic Color & Chemical Co., Inc.	XXVI
Carbide & Carbon Chemicals Corp.	
Chem-Col Company, Inc.	XLI
Ciba Company, Inc.	III
Clover Chemical Co.	
Coaltar Chemicals Corp.	XLI
Colgate-Palmolive-Peet Co.	
Commonwealth Color & Chemical Co.	
De Paul Chemical Co., Inc.	XXXI
Drew & Co., Inc., E. F.	XIII
Du Pont de Nemours & Co., E. I.	
Dyestuff Division	
Fine Chemicals Division	
Emery Industries, Inc.	VI
Fancourt & Co., W. F.	
Geigy Company, Inc.	Front Cover
General Chemical Division, Allied Chemical & Dye Corp.	
General Dyestuff Corp.	XI
Girdler Corp., The	
Grinnell Co., Inc.	
Gurley, W. & L. E.	
Hardesty Co., W. C.	XVIII
Hart Products Corp.	
Hercules Powder Co.	
Heyden Chemical Corp.	
Hooker Electrochemical Co.	
Houghton & Co., E. F.	XV
Interchemical Corp., Textile Colors Div.	XIX, XX
International Nickel Co., Inc.	
International Salt Co., Inc.	X
Kali Manufacturing Co.	XXXVI
Kelco Co.	XXIII
Laurel Soap Mfg. Co., Inc.	
Leatex Chemical Co.	XXXVI
Leeds & Northrup Co.	
Mac Beth Corp.	
Maher Color & Chemical Co.	
Mathieson Alkali Works, Inc.	
Maxim Chemical Co., Inc.	XXXVII
Maywood Chemical Works	VIII
Monsanto Chemical Co.	XXVIII
Myles Salt Co., Ltd.	
National Aniline Division, Allied Chemical & Dye Corp.	VII
National Carbon Co., Inc.	
National Starch Products, Inc.	
Napco Chemical Co.	XVI
Nova Chemical Co.	XXXI
Nuodex Products Co., Inc.	
Nyanza Color & Chemical Co., Inc.	XII
Onyx Oil & Chemical Co.	XXIV
Oronite Chemical Co.	
Pabst Sales Company	
Perkins & Sons, Inc., B. F.	
Philadelphia Quartz Co.	
Procter & Gamble	
Refined Products Corp.	V
Richmond Oil Soap & Chemical Co., Inc.	XXXI, XXXVII
Riggs & Lombard, Inc.	XXXIII
Rohm & Haas Company	XLII
Rona & Co., Inc., L. L.	
Royce Chemical Co.	Back Cover
Rumford Chemical Works	
Sanders & Sloat, Inc.	XXX
Sandoz Chemical Works, Inc.	XXIX
Scholler Bros., Inc.	
Shepard Chemical Corp.	XXXIII
Sindar Corporation	
Smith Drum & Co.	
Solvay Sales Div., Allied Chemical & Dye Corp.	XXXII
Sonneborn Sons, Inc., L.	
Standard Brands, Inc.	
Standard Chemical Products, Inc.	
Stein Hall & Co., Inc.	XXI
Tennessee Eastman Corp.	XVII
Titan Chemical Products, Inc.	
Union Carbide & Carbon Corp.	
United Chemical Prod. Corp.	XXXV
Van Vlaanderen Machine Co.	
Virginia Smelting Co.	XXXVI
Wallerstein Co., Inc.	XXV
Warwick Chemical Co.	
Watson-Park Company	XXII
Wolf & Co., Jacques	
Young Aniline Works	XXX
Young Co., J. S.	
Zinsser & Co., Inc.	
Zurn Co., O. F.	XLI

ANILINE OIL
•
CRESYLIC ACID
•
XYLIDINE

COALTAR CHEMICALS CORPORATION

William D. Neuberg, President

GRAYBAR BLDG., 420 LEXINGTON AVE., NEW YORK 17, N.Y.

TELEPHONE: MURRAY HILL 5-9508

CABLE: "COALTARKEM"

EXPORTERS—IMPORTERS

Aniline Colors • Dyestuffs • Pigments

and

Textile Chemical Auxiliaries

CHEM-COL COMPANY, INC.

82 WALL STREET NEW YORK (5), N. Y.

CABLE ADDRESS: COLORANTES NEW YORK, ALL CODES

prevent

pick-ups . .

pulled threads

with

NYLON OIL #82

Help yourself to better production. Nylon Oil No. 82 keeps seconds or irregulars down to as little as 2% in running 10, 15 and 20 denier nylon. Specially blended to overcome the effects of dyeing and pre-boarding. Used straight, not in an emulsion with water or other products. If you'd like to test this new oil under operating conditions, we'll gladly send you a sample. Write today.

Available in quantity, the oil cup illustrated here can be used on full fashioned or seamless hosiery machines.

Specialties for

SCOURING

STRIPPING

PENETRATING

FINISHING

LUBRICATION

Zurnoil

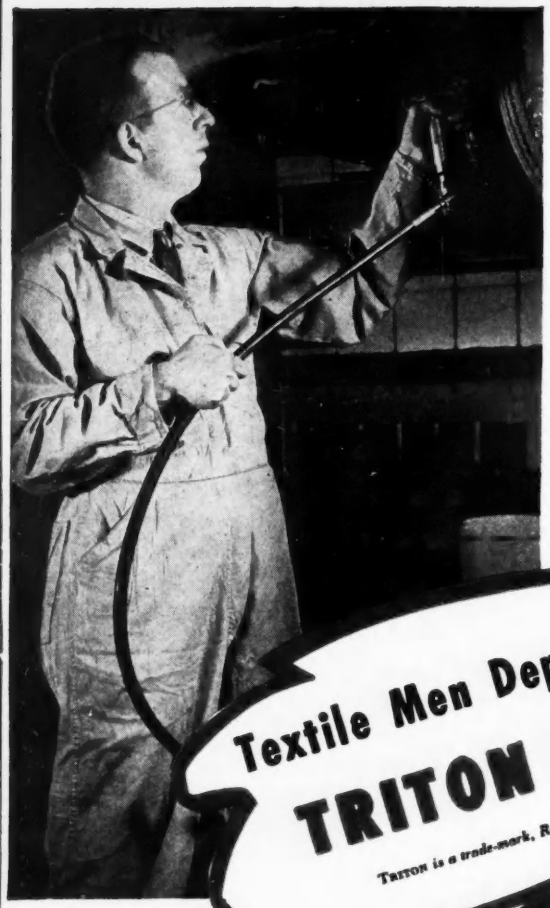
TEXTILE CHEMICALS

Oils for all textile conditioning requirements.

O. F. ZURN COMPANY

PHILADELPHIA 32, PA.

Knoxville, Tenn. • Hamilton, Ontario, Canada



From Cotton Twills

TO

Bemberg Sheers

Courtesy American Bemberg Corporation.

Textile Men Depend on TRITON 770

TRITON is a trade-mark, Reg. U. S. Pat. Off.

No matter what kind of fabrics they make or finish . . . whether it is triple sheer rayons or heavy cotton twills . . . textile men know they can rely on TRITON 770 CONCENTRATE for assured uniformity in desizing, boiling off and kier boiling. ¶ But this versatile chemical does many other jobs which make textile mill operations more efficient and more economical. Write for complete information on how TRITON 770 can help *you* with your specific applications.

CHEMICALS FOR FINE TEXTILES

Represented in Canada by Rohm & Haas Company of Canada, Ltd., Toronto; and in South America by Cia. Rohm y Haas, S. R. L. Carlos Pellegrini 331, Buenos Aires, Argentina, and agents in principal South American cities

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics • Synthetic Insecticides • Fungicides • Enzymes • Detergents
Germicides • Chemicals for the Leather, Textile, Ceramic, Rubber, Paper, Petroleum and other Industries

Those are the advantages of

LIQUID BECCO HYDROGEN PEROXIDE

when you order Becco in tank cars...and use Becco tank storage.

● More and more users of Becco Hydrogen Peroxide are finding entire satisfaction in bulk shipments and bulk storage. The simplicity in handling...the quickness of transfer...adds greatly to production and subtracts substantially from costs. 40,000 lbs. in 1½ hours can be handled through the turning of a valve and the pushing of a button.

Becco's fleet of tank cars is the largest in the hydrogen peroxide industry. Becco's representatives will arrange and plan with you for the most efficient tank storage.

Write for complete information.

BECCO SALES CORPORATION

AGENTS FOR BUFFALO ELECTRO-CHEMICAL COMPANY, INC.

BUFFALO 7, NEW YORK

New York Boston Philadelphia Chicago Charlotte

VATROLITE

For pleasing the hard-to-please when dyeing indigo on wool, vat colors on cotton, linen, silk, and rayon — in general stripping work on cotton and rayon — your best bet is Vatrolite.

VATROLITE DOES NOT DUST . . . Granular character — it's easy to handle.

DOES NOT LOSE STRENGTH . . . Kept dry, it retains full power over longer periods . . .

DECOMPOSES SLOWLY IN DYEBATH . . . Regular, even results.

UNIFORM . . . Strict manufacturing control for top performance.

Remember these two important points! Vatrolite is a *better* reducing agent. It's made only by Royce.

A BETTER REDUCING AGENT . . .

made only by ROYCE

ROYCE CHEMICAL CO.

CARLTON HILL, NEW JERSEY

MANUFACTURERS OF NEOZYME* • PAROLITE* • DISCOLITE* • DRYTEX* FABRITEX* • GUMOLITE* • CASTROLITE* • VELVORAY* • ZIPOLITE*

ROYCE CHEMICAL CO.

*Reg. U.S. Pat. Off.

4077